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ABSTRACT

This course workbook is designed to help students understand the principles of active learning, student assessment, and team training used in Arizona State University's core engineering curriculum. Eight sections focus on: (1) active learning, teaching and learning styles, and cooperative learning; (2) student assessment, levels of learning, and degrees of internalization, (3) a guide to self-evaluation and the documentation of educational states; (4) the use of teams; (5) team dynamics and effectiveness; (6) communication skills and teamwork; (7) tools for effective team decision-making; and (8) competency matrices for student self-evaluation. (MDM)

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ED 384 315

Engineering Core Workbook
for
Active Learning, Assessment & Team Training

Prepared by

Barry W. McNeill and Lynn Bellamy

College of Engineering and Applied Sciences
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Acknowledgments:

Some of the materials in this workbook were excerpted from a number of sources. In most cases, the original reference or source has been cited. Additions, deletions, changes and other adaptations have been made to the original materials but are not specifically denoted herein. The materials provided by Karl A. Smith, a Civil Engineering professor at the University of Minnesota and expert in Cooperative Learning, are included without citation. Some of the materials and formats were developed by ASU's "Organic" Continuous Quality Improvement Team members Lynn Bellamy, Chemical Engineering, Don Evans, Mechanical & Aerospace Engineering, Eric Guilbeau, Bio Engineering, Darwyn Linder, Psychology, Susan McHenry Malaga, Administrative Services, Barry McNeill, Mechanical & Aerospace Engineering, Jack Pfister, Public Affairs and Greg Raupp, Chemical Engineering. The support of the National Science Foundation under Grant USE 9156176 is hereby acknowledged. Finally, we are indebted to Susan Ledlow in Faculty Development at ASU for introducing us to Cooperative Learning.

Spring 1995 **© McNeill 1995** **Second Edition**

HE 028428

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Preface

Most of you will find that this course is managed and delivered in a way that differs from your prior classroom experiences. Consequently, many of you may find the approach unusual and perhaps a few of you will find the approach disturbing. It is important that you be aware of (and eventually understand and perhaps value) the reasons for these differences in course management and delivery. The two most important considerations, the ones which most strongly motivate how the class is managed, are: 1) active student involvement and, 2) the role of (course) expectations.

Active Student Involvement

Haven't you always been involved, gone to class, done the assigned reading and work, and taken the tests? Of course you have, and you will continue to do so in this class; however, active student involvement goes beyond these activities. What involvement did you have in:

- selecting the assignments or the topics to be covered;
- improving the course in real time (i.e., while you were taking it);
- deciding how the testing was to be done;
- establishing course goals;
- helping class colleagues to master the material?

You have probably had little if any involvement in these activities which are the very activities that are included in the term *active student involvement*.

Would you like to be *actively* involved? Probably yes, although you may wonder if this type of student involvement is educationally sound; will it degrade the class and the educational experience? The answer is an overwhelming NO. In fact, research has clearly shown that active involvement actually leads to a significant upgrade of most classes. Every current journal of education or educational research has at least one article extolling the benefits of some aspect of active student involvement. The bottom line is: the more you are involved in deciding how a course is managed (i.e., constructing your learning environment) the more you learn and the more you value the learning process.

This body of evidence, collected and analyzed by educational experts cannot be ignored in engineering education any more than we can ignore the laws of physics; therefore, for the past two years, we have been actively changing our course management to incorporate these research findings. This has not been easy. It is one thing to agree philosophically with this data but an entirely different matter to actually incorporate it into my value structure, especially since we have spent virtually our entire life in a learning culture which says that we, as the professors, are right and make all the decisions.

Considerable effort and hard work have gone into making the transformation in my classrooms; however, we have found that our efforts have not been one hundred percent successful. Some methods and activities that we have tried have worked and the results have been fantastic; other methods and activities have not worked as well and when this happened the students tended to become frustrated (angry) and reluctant to continue trying to make the class work[1]. We have eliminated or modified those activities which have not worked; however, we have also added some new activities to provide additional opportunities for you to be significantly and actively involved in the class.

In this class *active* involvement means you will:

1. help select some of the problems to be studied during the semester
2. make real time suggestions on how to improve the course
3. help develop some of the course expectations
4. help colleagues learn

The Role of (Course) Expectations

Expectations[2] , We have them, you have them, Society has them; but what is their role in a course? Without expectations assessment is not possible. Expectations establish the baseline to which work is compared (benchmarked). When assessing work, the assessor's task is to determine if the work meets, exceeds, or falls short of expectations. Thus, assessment requires explicit expectations; however, **you cannot do any work until you know the expectations**. You have to know what you are trying to accomplish. You can no more prepare work before knowing the expectations than you can prepare a design before knowing the requirements.

Historically, classwork expectations were established after the work was completed (when it was no longer of use to you), established solely by the course instructor, and were often poorly explained or presented to you. Even when expectations were discussed, the discussion often took place at a level of detail that made the discussion virtually meaningless (e.g., *I expect you to convince me*; or, *do a complete job*). There is too much room for honest interpretation about what *do a complete job* might mean. Expectations such as *do a complete job* are a starting point but are no more useful than a design requirement of *must be reliable*. To be useful, expectations (and design requirements) must be defined at a level of detail that is either quantifiable or has little room for personal interpretation.

We want to change this historical method of establishing expectations. First, we want you to be involved in establishing expectations. The work in educational research shows that students produce much better work when they are involved in establishing the expectations for the work. Second, we want the expectations to be defined at an operational level, one you can use when developing and assessing your work. And third, we want these expectations to be established before the work is started (or at least well before it is completed). This gives you the target and helps keep the target from moving.

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[1] This is not a desirable situation and is the motivation for preparing these notes on the course. I want to lessen these feelings of frustration with new things that do not seem to work so that we can work out solutions and improvements and not just feel bad. Active involvement requires suggestions from you on how to improve the course.

[2] We are using the term *expectations* to refer to things which will occur (be present) and not to refer to things which we hope will occur (be present).

This workbook contains a set of slides for the first few class periods in which teams, team building and assessment are discussed. Section C contains a guide to help you do assessment. We are not expecting you to become overnight experts at any of this material but we are hoping that by the end of the semester you will be willing to participate in an active student classroom.

So kick back, get ready to work and let's have a fun semester.

LB & BWMcN

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Schedule for Engineering Core Active Learning and Assessment

Total Time	*Time*	***Class Period 1 : Active Learning***
10	10	Contact Before Work
20	10	Getting Started
40	20	Introduction to Active Learning
60	20	Pigs Face Jigsaw
70	10	**Break**

Total Time	*Time*	***Class Period 2 : Assessment***
5	5	Contact Before Work
13	8	Getting Started
28	15	Introduction to Assessment
28		Levels of Learning Jigsaw
62	34	Becoming an Expert
72	10	**Break**
90	18	Delivering Tutorials
110	20	Introduction to Competency Matrices

Schedule for Engineering Core Team Training

Total Time	Time	***Class Period 3 : Jigsaw Part 1***
10	10	Clearing and Getting Started
20	10	Teams Lecturette
40	20	Learning the Material
75	35	*Meetings, Bloody Meetings* Video
85	10	**Break**
105	20	Develop Tutorial
110	5	Session Process Check (+/delta)

Total Time	Time	***Class Period 4 : Jigsaw Part 2***
5	5	Clearing and Forming New Teams
40	35	Teach the Material (5 Topics x 7 Minutes/Topic)
55	15	Jigsaw Process Check (Likert Scale)
65	10	**Break**
70	5	Academic Journal Introduction
Total Time	Time	***Class Period 4 : Team Norms Part 1***
85	15	Communication Skills & Norms Lecturette
110	25	*Team Player* Video

Total Time	Time	***Class Period 5 : Team Norms Part 2***
0		
10	10	Clearing and Review
35	25	Communications Promoters & Barriers
70	35	Developing Norms
80	10	**Break**
95	15	Discussion and Constructive Feedback Practice
100	5	Session Process Check (+/delta)
110	10	Academic Journal Entry

SECTION A
Active Learning

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A-1

Today's Class Activities

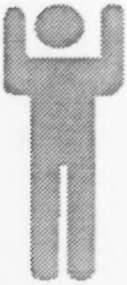
- Before Class Starts
  - find a table (area) with no more than five people
  - try to find a table at which you know at most one person
- Contact Before Work (10 minutes)
  - introduce yourself
  - find out who traveled the farthest to class today
- Getting Started (10 minutes)
- Active Learning (40 minutes)
  - short introductory lecture (20 minutes)
  - jigsaw (PIGS Face) (20 minutes)
- Break (10 minutes)

A-2

The Environment and Purpose

- **Learning Environment**
  - Active (as opposed to Passive)
  - Group or team based
  - Workshop facilitators (not Lecturers)
- **Purpose and Expected Participant Outcomes**
  - Learn Major Principles of Active Learning
  - Practice Some Acetive Learning

‘Focus on Facilitator’ Signal



The facilitator needs your attention:

- *Raise your hands to inform your neighbors*
- *Finish your sentence*
- *Do NOT finish your paragraph*
- *Turn toward the Facilitator*

Issue Bin (a useful tool !)

- **Someone will be assigned to be the Issue Bin Collector**
- **The following issues will be assigned to the Issue Bin:**
  - **topics that will or may be addressed later**
  - **questions that can or should be deferred until the end of the workshop**
  - **items that can or should be the subject of future workshops**
- **Paraphrase the issue and record on the board or a piece of paper which is always visible**
- **At the conclusion of the session or workshop, the issues in the issue bin are brought out, one at a time, and discussed to see if they are still issues.**
- **Any issues which remain after the discussion must be addressed in a future workshop.**

A-5

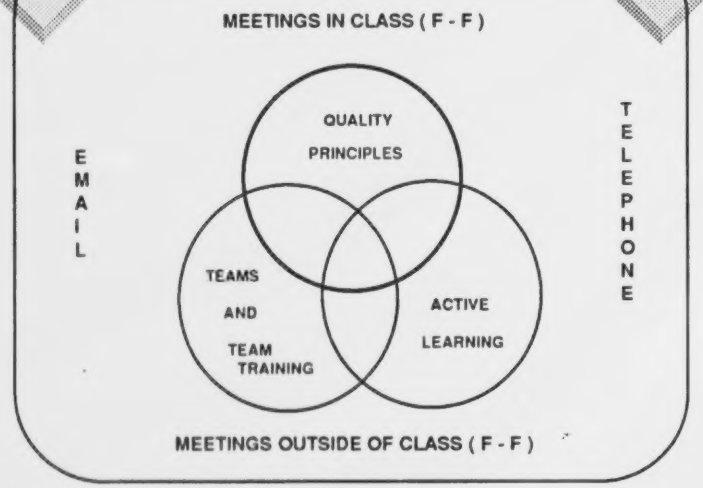
Code Of Cooperation

1. EVERY member is responsible for the team's progress and success.
2. Attend all team meetings and be on time.
3. Come prepared.
4. Carry out assignments on schedule.
5. Listen to and show respect for the contributions of other members; be an active listener.
6. CONSTRUCTIVELY criticize ideas, not persons.
7. Resolve conflicts constructively.
8. Pay attention, avoid disruptive behavior.
9. Avoid disruptive side conversations.
10. Only one person speaks at a time.
11. Everyone participates, no one dominates.
12. Be succinct, avoid long anecdotes and examples.
13. No rank in the room.
14. Respect those not present.
15. Ask questions when you do not understand.
16. Attend to your personal comfort needs at any time but minimize team disruption.
17. HAVE FUN !!!
18. ?

adapted from the Boeing Airplane Group team Member Training Manual

A-6

A Proposed Learning Culture


MEETINGS IN CLASS (F - F)
EMAIL
QUALITY PRINCIPLES
TEAMS AND TEAM TRAINING
ACTIVE LEARNING
TELEPHONE
MEETINGS OUTSIDE OF CLASS (F - F)

A-7

Active (Cooperative) Learning

- A technique used in the classroom which employs student-student and student-facilitator (faculty) interaction in various forms to convert the learning environment from PASSIVE to ACTIVE
- Enhances learning
- Substantially improves retention
- Increases in value as the material increases in conceptual difficulty

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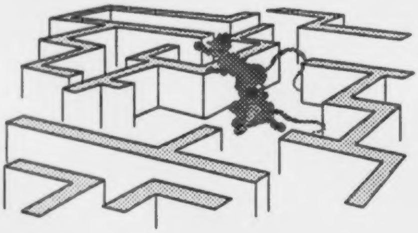
A-8

Teams and Team Training

- Is used to enhance the performance of a 'group'
  (i.e., group ==> Team)
- Applies both INSIDE and OUTSIDE the classroom
- Applies to both faculty and students
- Does NOT just happen;
  training is required !



A-9

Quality Principles

- Standardized processes, elementary tools, and a philosophy employed to induce a systemic change in the learning environment
- Elements include:
  - continuous improvement of the process of education guided by timely feedback from customers
  - criterion-based assessment (e.g., a competency matrix)
  - testing as a feedback mechanism, not as a method for introducing variance
  - trust rather than fear
  - cooperation, not competition, at all levels
  - developing intrinsic, not extrinsic motivation
  - an integrated curriculum
  - patience and persistence

A-10

We hold these truths also to be self evident:

- *Life is for learning.*
- *Different people learn differently and have a right to pursue learning in their own style as well as a need to learn the styles of others.*
- *Everyone is an educational institution, has something to teach, and something to learn.*
- *Life is eclectic. No one way of teaching, learning, or leading fits all situations.*
- *We don't succeed until we all succeed.* (12)

A-11

ASU....THE STUDENT IS ...

. . . a critical and important member of the University family

. . . working hard to develop his or her potential to its fullest.

. . . a flesh and blood human being with feelings and emotions.

. . . multifaceted - old, young, black, white, red, brown, yellow, male, female, married, single, liberal, conservative, rich, and poor.

. . . the purpose of our work.

Students pay us a compliment by trusting us to serve them.

A message brought to you by the Associated Students of Arizona State University

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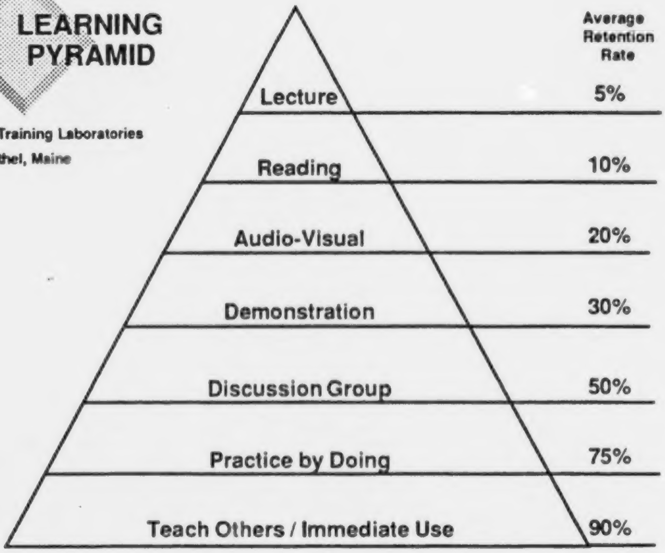
A-12

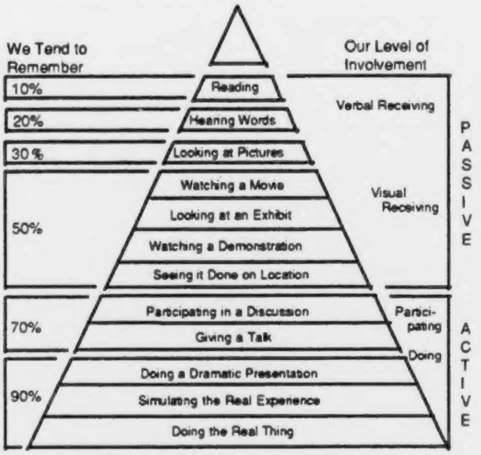
LEARNING PYRAMID

National Training Laboratories
Bethel, Maine


Average Retention Rate
Lecture
5%
Reading
10%
Audio-Visual
20%
Demonstration
30%
Discussion Group
50%
Practice by Doing
75%
Teach Others / Immediate Use
90%

A-13

Cone of Learning / Another View



We Tend to Remember

Our Level of Involvement

10% — Reading

20% — Hearing Words

Verbal Receiving

30 % — Looking at Pictures

50% — Watching a Movie; Looking at an Exhibit; Watching a Demonstration; Seeing it Done on Location

Visual Receiving

PASSIVE

70% — Participating in a Discussion; Giving a Talk

Partici-pating

Doing

90% — Doing a Dramatic Presentation; Simulating the Real Experience; Doing the Real Thing

ACTIVE

Effectiveness of Learning Modes

A-14

Consequences of Teaching and Learning Style Mismatch

(Felder, FIE Meeting, Nashville 1992)

Students:

- Become frustrated, bored and inattentive
- Do poorly on tests
- Get discouraged about the course, curriculum, themselves
- Change to another curriculum or drop out

Faculty:

- Get defensive or hostile
- Question their choice of profession; focus on research

Society loses potentially excellent engineers:

- visual, active, reflective learners (most students)
- inductive learners and sensors (experimentalists, plant engineers)
- global learners (systems thinkers, creative researchers)

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Consequences ... summary

- **Students may tend toward**
  1. ***Sensing*** **or** ***intuitive*** **perception**
  2. ***Visual*** **or** ***verbal*** **input**
  3. ***Inductive*** **or** ***deductive*** **organization**
  4. ***Active*** **or** ***reflective*** **processing**
  5. ***Sequential*** **or** ***global*** **understanding**

- **All combinations of types are needed in science and engineering**

- **Most of our teaching is** ***abstract*** **(intuitive),** ***verbal, deductive,*** **and** ***sequential.*** **Students in our classes tend to be passive.**

- **To best serve all our students we should be reaching all types, not just one.**

- **If we don't, students suffer, we suffer, and society loses valuable contributors.**

*Excerpts from a review of Richard J. Lights's Harvard Assessment Seminars (1990 and 1992 Reports)**

- "...the single teaching technique that dominates both the 1990 and 1992 reports is the use of small groups
- Small group work was considered as especially effective for science majors and women
- and as virtually essential for women in math and science."

*Jim Cooper, *Cooperative Learning and College Teaching,* Volume 4, Number 1, Fall 1993, page 15

A - 17

Some Cooperative Learning Structures and Procedures (7)
(Bits & Pieces)

- Think-Pair-Share or Formulate-Share-Listen-Create
- Numbered Heads Together
- Simple Jigsaw and Extended or Complex Jigsaw
- Group Discussion with Talking Chips
- Three Minute Essay
- Structured Controversy

A - 18

Cooperative Learning Bromides
(Bits & Pieces)

Contact Before Work
(i.e., provided for some brief exchange between participants)

Begin With the End in Mind
(i.e., specify the objective or competencies of the experience)

Need to Know Before Knowledge
(i.e., develop an interest in or need to know the material, or competencies, to be realized from the experience)

Structure Before Task
(i.e., communicate the structure or how the task is to be accomplished before commencing the task)

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Cooperative Learning Bromides (continued)

Balance Process (the How) with Content (the What)
(i.e., during the experience, balance the time and focus on the process as well as on the Content/Task/Product)

Check for Understanding at Critical Points or Times
(e.g., have someone paraphrase the structure, task, or conclusion before proceeding with the next step)

Process Check
(e.g., perform a process check at the end of the experience or at important interim steps using "+delta", checklists or other forms to obtain timely feedback from the participants)

Reflection
(i.e., pause for brief or even extended periods to think about what you have learned and/or the process used to learn; keep an academic journal of your reflections

Essential Elements of Active Learning (4)

- Positive Interdependence
- Individual Accountability
- Group Processing
- Social Skills
- Face to Face Interaction

"P I G S Face"

A Simple Jigsaw Exercise

- **Count off in your groups from 1 to 5**
- **Depending on your number you will read a paragraph (3 minutes)**
  - **1's read about Positive Interdependence**
  - **2's read about Individual Accountability**
  - **3's read about Group Processing**
  - **4's read about Social Skills**
  - **5's read about Face to Face Interaction**
- **Prepare a 1 minute tutorial on your reading to teach your other group members what you have learned (5 minutes)**
- **In sequence deliver the tutorials (5 minutes)**
- **I will call, at random, for discussion of these paragraphs (5 minutes)**

Positive Interdependence

Positive Interdependence exists when students believe that they are linked with others in a way that one cannot succeed unless the other members of the group succeed (and vice versa).

Students are working together to get the job done. In other words, students must perceive that they "sink or swim together."

In a problem-solving session, positive interdependence is structured by group members

(1) agreeing on the answer and solution strategies for each problem (goal interdependence) and

(2) fulfilling assigned role responsibilities (role interdependence).

Other ways of structuring positive interdependence include having common reward, being dependent on each other's resources, or a division of labor.

Individual Accountability

Individual accountability/Personal Responsibility requires the teacher to ensure that the performance of each individual student is assessed and the results given back to the group and the individual.

The group needs to know who needs more assistance in completing the assignments and group members need to know they cannot "hitch-hike" on the work of others.

Common ways to structure individual accountability include:

- giving an individual exam to each student,
- randomly calling on individual students to present their group's answer,
- giving an individual oral exam while monitoring group work (e.g., while the individual student is delivering an 'expert' tutorial to a small group).

Group Processing

Group processing (e.g., process check) involves a group discussion of how well they are achieving their goals and how well they are maintaining effective working relationships among members.

At the end of their working period the groups process their functioning by answering two questions:

(1) What is something each member did that was helpful for the group and

(2) What is something each member could do to make the group even better tomorrow?

Such processing: (1) enables learning groups to focus on group maintenance, (2) facilitates the learning of collaborative skills, (3) ensures that members receive feedback on their participation, and (4) reminds students to practice collaborative skills consistently.

A-25

Social Skills

Social (collaborative) skills are necessary for effective group functioning.

Students must have and use the needed leadership , decision-making, trust-building, communication, and conflict-management skills.

These skills have to be taught just as purposefully and precisely as academic skills.

Many students have never worked cooperatively in learning situations and, therefore, lack the needed social skills for doing so.

A-26

Face to Face Interaction

Face to face promotive interaction exists among students when students

orally explain to each other how to solve problems,

discuss with each other the nature of the concepts and strategies being learned,

teach their knowledge to classmates, and

explain to each other the connections between present and past learning.

This face to face interaction is promotive in the sense that students help, assist, encourage , and support each other's efforts to learn.

SECTION B

Assessment, Levels of Learning, Degrees of Internalization

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B - 1

Session Agenda

	Duration	Start Time
• Before Class Starts		
• find a group with less than four members and sit down with them		
• Contact Before Work	5 min	
• Getting Started	8 min	
• Assessment - Introduction	15 min	
• Levels of Learning Jigsaw		
• becoming an expert	34 min	
• break	10 min	
• delivering a tutorial	18 min	
• Introduction to Competency Matrices	20 min	

B - 2

The Environment and Purpose

- Learning Environment
  - Active (as opposed to Passive)
  - Group or team based
  - Workshop facilitators (not Lecturers)
- Purpose and Expected Participant Outcomes
  - Become aware of what assessment entails
  - Become aware of how assessment is done
  - Become interested in the assessment process

‘Focus on Facilitator’ Signal

The facilitator needs your attention:

- *Raise your hands to inform your neighbors*
- *Finish your sentence*
- *Do NOT finish your paragraph*
- *Turn toward the Facilitator*

Issue Bin (a useful tool !)

- **Someone will be assigned to be the Issue Bin Collector**
- **The following issues will be assigned to the Issue Bin:**
  - **topics that will or may be addressed later**
  - **questions that can or should be deferred until the end of the workshop**
  - **items that can or should be the subject of future workshops**
- **Paraphrase the issue and record on the board or a piece of paper which is always visible**
- **At the conclusion of the session or workshop, the issues in the issue bin are brought out, one at a time, and discussed to see if they are still issues.**
- **Any issues which remain after the discussion must be addressed in a future workshop.**

Code Of Cooperation

1. EVERY member is responsible for the team's progress and success.
2. Attend all team meetings and be on time.
3. Come prepared.
4. Carry out assignments on schedule.
5. Listen to and show respect for the contributions of other members; be an active listener.
6. CONSTRUCTIVELY criticize ideas, not persons.
7. Resolve conflicts constructively.
8. Pay attention, avoid disruptive behavior.
9. Avoid disruptive side conversations.
10. Only one person speaks at a time.
11. Everyone participates, no one dominates.
12. Be succinct, avoid long anecdotes and examples.
13. No rank in the room.
14. Respect those not present.
15. Ask questions when you do not understand.
16. Attend to your personal comfort needs at any time but minimize team disruption.
17. HAVE FUN !!!
18. ?

adapted from the Boeing Airplane Group team Member Training Manual

What Do You Know?

- Do you know the symbol used for oxygen?
- Do you know the valence for oxygen?
- Do you know the obit or spin direction of the valence electrons?
- Can you balance the following chemical equation?
  - O_2 + H_2 -------> H_2O
- Can you write down and explain the half reactions that are associated with the above reaction?
- Can you propose a process for the creation of methyl alcohol (methanol CH_3OH)?

What Is Your Attitude?

- How do you feel when I tell you that molecular oxygen in our atmosphere is O_5?
- How do you feel when I tell you that the atomic weight in amu's of oxygen is 159, 15.9, 15.99, 15.999, 15.9993, 15.9994, 15.9995?
- How do you feel when I tell you that the valence electrons for oxygen are in the 2p orbital?
- How do you feel when I tell you that oxygen can be generated from moon rocks?
- How do you feel when I tell you that a new atomic element has been found in the last six months?

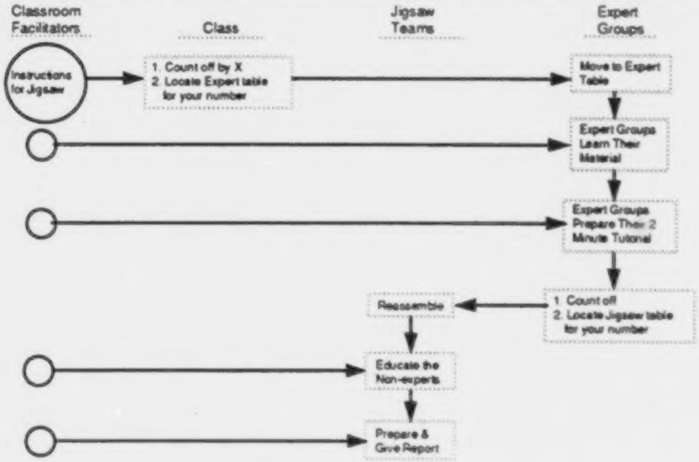
Levels of Learning (LoL) & Degrees of Internalization (DoI)

- Cognitive Aspects (thinking aspects)[1]
  - Knowledge
  - Comprehension
  - Application
  - Analysis
  - Synthesis
  - Appreciation (Evaluation)
- Affective Aspects (feeling aspects)[2]
  - Receiving
  - Responding
  - Valuing

[1] Bloom et al 1956

[2] Krathwohl et al 1964

LoL & DoI Jigsaw



Classroom Facilitators

Class

Jigsaw Teams

Expert Groups

Instructions for Jigsaw

1. Count off by X
2. Locate Expert table for your number

Move to Expert Table

Expert Groups Learn Their Material

Expert Groups Prepare Their 2 Minute Tutorial

1. Count off
2. Locate Jigsaw table for your number

Reassemble

Educate the Non-experts

Prepare & Give Report

Expert Reading

- **Everyone review Part I of the Self Evaluation Guide (Section C of Workbook)**
- **In addition, read from Appendix A of the Guide as follows:**
  - **Table 1 is to read Valuing & Knowledge**
  - **Table 2 is to read Receiving & Comprehension**
  - **Table 3 is to read Responding & Application**
  - **Table 4 is to read Valuing & Analysis**
  - **Table 5 is to read Receiving & Synthesis**
  - **Table 6 is to read Responding & Evaluation**
- **If you have people who do not have the Orange Workbook, please share your workbook for this exercise.**

Becoming An *Expert*

- Read the material that has been assigned to your *expert* table
- Discuss the reading with your *expert* team members to reach understanding on meaning and importance of the various ideas
- As a team, develop a two minute tutorial that you can use to teach other members of the class about your level or degree
- As an aid in preparing your table's tutorial prepare a class assignment that, if done, could be used to demonstrate mastery at your table's LoL. What sort of work product would be created by a person doing your assignment at your level?
  - if your group has become *experts* in either Knowledge, Comprehension or Application prepare an assignment on:

    ____

  - if your group has become *experts* in either Analysis, Synthesis or Evaluation prepare an assignment on:

    ____

Presenting The Tutorial

- The two minute tutorials should be delivered in the following sequence:
  - Receiving
  - Knowledge
  - Responding
  - Comprehension
  - Application
  - Analysis
  - Valuing (delivered by either fifth team member or person who did not do Analysis)
- It is a good idea to check each other to ensure that everyone is learning the material to at least the Knowledge LoL and Receiving DoI
- After all the tutorials have been delivered spend a few moments in clarification

B - 13

What is Assessment?

- Assessment is a process used to answer the questions:
  - what do you know ?
  - how well do you know it ?
- The answers to these questions are based on the evidence[1] that you supply to the person doing the assessing

[1] In this class all the evidence will be collected and organized in a Portfolio (see Part III of Self Assessment Guide in Section C of Orange Workbook for more information on Portfolios)

B - 14

Stages of Knowledge[1]

Self-Awareness

2 you know that you do not know (conscious incompetence)	3 you know that you know (conscious competence)	High
1 you do not know that you do not know (unconscious incompetence)	4 you do not know that you know (unconscious competence)	Low
Low	High	

Competence

[1] Mr. House - Hewlett Packard

The Workbook Competency Matrix

Open your Orange Workbooks to Section H and turn to page 2 of 5. For each of the following questions silently consider an answer and then share with your group members. A person selected at random will be asked to give an answer.

- What are some of the topics to be covered by the material in the workbook?
- How have the topics been organized on a page (you might like to look at the Tree Diagram on page G - 19)
- Is it assumed that you have any pre-knowledge about any of these topics before you came to class?
- What do the 2's, 3's, 4's, and 5's mean?
- What level of cognitive and affective behavior is expected after this class for
  - Knowledge
  - Synthesis
  - Reflection Logs

Updating Your Workbook Competency Matrix

- Look at each of the competencies
  - if you recognize that a competency was presented today put a check in the appropriate row under Receiving
  - for each competency that you checked for Receiving, find the slide in the workbook that introduced the competency and enter that slide number in the appropriate row under Knowledge.
- Find the competency for the items related to your tutorial
  - put a check in the appropriate row under Responding
  - for each competency that you checked for Responding, find the slide in the workbook that you used in developing your tutorial and enter that slide number in the appropriate row under Comprehension

SECTION C

A Guide to Self Evaluation and Documentation of Educational States

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A Guide
to
Self Evaluation and Documentation of Educational States

by

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With Deviations
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Preface

In this class you will be creating a Portfolio of your work and developing a special index to this work. A *Portfolio* is just a fancy name for an organized collection of all the work you will undertake during the semester. Some of you may already have methods for organizing your work; however, in this class you will be asked to organize the work in a specific manner which will allow a simplified means of assessing your performance. At the end of the semester your Portfolio will contain the **evidence** of what you did and, by implication, **evidence** of what you have learned. Theoretically, it should be possible at the end of the semester for anyone who knows the course expectations to look through your collection of work and decide how well you did in meeting those course expectations (i.e., assess your performance). The grade you receive in the course is a function of this type of assessment.

The assessment job can be simplified if it is easy to find the specific work that is related to a specific course expectation. For example, if during the course it is expected that you will learn how to extract derivatives of trigonometric functions, it would help to know where in your Portfolio there is work related to extracting trigonometric derivatives. This connection from expectations to specific pieces of work can be constructed in several ways; however, in this class the connection will be created using an index known as a *Competency Matrix*. You will build this index continuously during the semester as you do your course work and put it into your Portfolio.

You may be asking yourself *Why all the fuss with Portfolios and Matrices? What was wrong with the old way of just submitting the work and getting a grade?* Using Portfolios and a Competency Matrix greatly enhances the assessment process: first, assessment is more uniform (i.e., fairer); second, individuals other than the course instructor may do the assessing. In particular, it makes it possible for **you** to do the assessment. Exactly how much self assessment you actually do will be a function of the specific course and faculty; however, you can expect to do some self assessment, and in some cases you may do the majority of assessment.

Acknowledgments

The material presented in the Guide is a compilation of the thoughts and experiences of Drs. Jim Bailey, Lynn Bellamy, Don Evans, Mark Henderson, Darwyn Linder, Barry McNeill, Jack Pfister, and Greg Raupp as they attempted to utilize the concept of a competency matrix in the evaluation of student performance in their classes during the last several years.

LB & BWMcN

Part I -- Introduction

Have you ever wondered:

1. what an education is, or
2. what it means when you *learn* something, or
3. if you only learn in school, or
4. whether your education stops when you leave school?

These are not easy questions to answer and some people spend their entire lives attempting to formulate answers; however, difficult as it may be, you do need to think about answers to these questions. Before reading further you might like to jot down some reflections on these questions.

Education and Learning

So what are some answers to these questions. Starting with the most difficult, i.e., question 1, *education* is defined in *The Random House College Dictionary* as:

> the act or process of imparting or acquiring general knowledge and of developing the powers of reasoning and judgment.

This shows *education* to be an active, dynamic thing (*imparting*, *acquiring*, *developing*). *Education* causes a change in your general knowledge and/or in your ability to reason and to use judgment.

Following this definition it seems reasonable to expect *learning* to be associated with the actual *acquiring* or *developing* part of this definition. When you *learn* a history lesson you are obtaining knowledge about the activities going on during some period of time. When you *learn* to drive a car you gather knowledge about the car, the rules of the road, and develop a sense of when it is and is not safe to pass, a reasoning/judgment activity. So *learning* is the method or way by which you acquire and develop knowledge and wisdom. There is no single, correct, way to learn something; different people learn things in different ways.

The third question, suggesting that you can only learn something in school, is clearly erroneous. School in only one of the many places that you learn. You certainly learned how to walk and talk outside of school. You learned to drive a car outside of school. In fact, much of your learning takes place outside of school. Education is not limited to schools or universities.

Life Long Learning

Now to the last and probably most important of the four questions: does the end of schooling mean the end of education? The answer is a resounding NO. In fact, your education never stops. If you want to continue to be a productive and useful person you must continue to learn throughout your life. As your interests and needs mature and change you need to acquire and develop new information and judgmental skills. A university degree merely starts you down the road of life long learning.

If the University does not complete this education process, what does it do? Universities help you move to adulthood with its myriad of responsibilities. At the undergraduate level, Universities are learning environments that help you *learn how to learn* so you, as an adult, can take full responsibility for your own education. Universities help you to learn[1] at a time when you may not be mature enough or have enough knowledge to know what you need to learn. However, Universities must eventually wean you from depending on authority figures to define what you need to learn; eventually you will leave the University and unless you know how to learn, your education will stop prematurely at graduation.

---

[1] e.g., a structured curriculum

Introduction

The primary goal of a University is to graduate Life Long Learners, people who can learn by themselves, people who can learn and want to learn autonomously. Philip Candy has developed a set of characteristics of an Autonomous Learner (Figure 1). Read through Figure 1 and see how many of these traits apply to you. Do not be overly concerned if the answer is *not many;* much of what you will do in this class is aimed at starting the change in your attitude toward learning; i.e., moving you closer to the profile of the autonomous learner.

Educational States

By definition, education is a process, which means that things change. So what is changing and how do you measure this changing quantity? What is changing are your behaviors, attitudes, knowledge, skills, and reasoning powers. This collection of attributes is covered under the umbrella concept of an Educational State. Thus, the definition of education becomes:

> Education is the process that changes a person's educational state

Traditionally, the evaluation of the status of your educational state has been done by course instructors who assign a grade to indicate your **state**. While it may be relatively easy to let instructors do this evaluation of your work (i.e., you do the assigned work, submit the work, and wait to see what the instructor reports), in the long term you must be the person doing the evaluation. You cannot continually rely on someone else to tell you how you are doing; you must learn how to evaluate your own educational state so you can make the required improvements.

How can educational states be defined or characterized? While there are many ways to do this, one way is to characterize your educational state by the activities and actions (i.e., behaviors) of you and your teacher. Reflect back over your time in school; you should be able to recognize the major changes that have taken place in your activities. During the first several years you learned facts and worked **simple, single concept** problems; during the latter years you worked problems that combined many different concepts and skills.

In the early 1950's a group of educational psychologists addressed the problem of defining educational states. To quote from the Foreword to their first efforts:

> It (this work) is intended to provide for classification of the goals of our educational system. It is expected to be of general help to all teachers, administrators, professional specialists, and research workers who deal with curricular and evaluation problems. It is especially intended to help them discuss these problems with greater precision.[2]

These psychologists divided the problem into three behavioral domains: the cognitive, dealing with the *recall or recognition of knowledge and the development of intellectual abilities and skills*; the affective, dealing with *interests, attitudes, appreciations, values, and emotional sets or biases and* the psychomotor, dealing with the *manipulative or motor-skill area.* These psychologists attempted to define a finite set of recognizably distinct behaviors and then sequence these behaviors in the order they occur when someone is learning (i.e., they were striving to define a taxonomy of cognitive, affective, and psychomotor behaviors associated with learning).

Cognitive Domain

A taxonomy[3] (a handbook), that dealt with the cognitive domain, was published in the mid 1950's. After much discussion and testing of ideas with a wide range of colleagues, Bloom et al. proposed a cognitive taxonomy containing six major categories. In order of increasing complexity (and learning) they were: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. Each of these categories was characterized by a different set of abilities (behaviors) exhibited by a person operating in the category. This taxonomy was widely accepted and is the basis for many curriculum development efforts.

---

[2] *Taxonomy of Educational Objectives Book 1 Cognitive Domain*, Bloom et al, Longman, 1956.

Learners Capable of Autonomous Learning Will Characteristically:

Be Methodical / Disciplined

- Be able to focus on an area of interest
- Develop individual plans for achieving goals
- Establish personal priorities
- Pay close attention to details of an ongoing project

Be Reflective / Self-Aware

- Decide what knowledge and skills to learn
- Have a self-concept as an effective learner
- Know his or her strengths and weaknesses
- Understand his or her own values, interests, abilities, and knowledge

Demonstrate Curiosity / Openness / Motivation

- Be curious, with a continual need to learn
- Be "cognitively open" with regard to phenomena
- Confront questions and problems willingly

Be Flexible

- Be able to learn in many situations - from conversations, through reading, and by observation
- Be able to learn from listening, taking notes, reading, or memorizing
- Be able to accept or reject material
- Be able to achieve or abandon goals

Be Persistent / Responsible

- Be capable of intellectual concentration
- Stick to plans, modifying as necessary
- Have a tolerance for frustration
- Detect and cope with personal and situational blocks to learning

Have Developed Information Seeking and Retrieval Skills

- Intelligently select and use most relevant sources of information
- Identify, and know how to use, resources appropriate to different kinds of learning objectives
- Be able to establish feedback mechanisms for day-to-day performance

Have Knowledge About and Skill in "Learning Processes"

- Be capable of reporting what he or she has learned in a variety of ways
- Be able to decode a message - textual, auditory, or visual
- Have developed skills in taking notes, remembering, and relating

Develop and Use criteria for Evaluating

- Be able to select what is of value from the mass of information available
- Participate in diagnosing, prescribing, and evaluating his or her own progress

Figure 1 Profile of the Autonomous Learner[3]

---

[3] Excerpted from : Philip A. Candy, Self-Direction for Lifelong Learning. San Francisco, Jossey-Bass, 1991, pp 459 - 466

Introduction

In the late 1980's and early 1990's David Langford, in attempting to implement an important aspect of the quality culture (empowerment) into the classroom, recognized that the cognitive taxonomy could be used by the students as well as the teachers to determine where they were relative to these various objectives. Langford proposed having the students use these educational objectives to do self evaluation. Langford renamed the objectives Levels of Learning, changed the name of Comprehension to Know - How, and developed summaries of the types of activities a student and teacher would undertake when they, the students, were operating at these various Levels of Learning[4].

A modification to Langford's material on typical activities can be found in the first six pages of Appendix A. This material consists of answers to a set of seven standard questions. The answers to the questions change as the Level of Learning changes. For example, at the Knowledge Level the question *How do I know I have reached this level?* is answered , *I recall information;* at the Synthesis Level the same questions is answered, *I have the ability to put together parts and elements into a unified organization or whole that requires original, creative thinking,.* Carefully read the answers to these questions in Appendix A, paying especially close attention to the first two and last three questions for each of the levels.

Affective Domain

As the psychologists had pointed out in the 1950's, there is more to defining an educational state than is covered by cognitive behaviors (Levels of Learning). There are the affective behaviors that must also be considered. These affective behaviors cover a wide variety of issues ranging from the willingness to receive and try new material, or the interest in what is being learned, to a sense of value with regard to what is being learned or how the material is being learned. Aside from these sorts of issues, the affective domain also involves the related issue of Character (honesty, integrity, truthfulness, etc.). Myron Tribus, in several of his recent essays[5], states that Character is one of the major categories of attributes that should be cultivated in a school or university.

What are the affective stages you pass through during the learning process? In the mid 1960's a subset of the group of educational psychologists who had produced the cognitive taxonomy published a second taxonomy[6], one that dealt with the affective domain. Compared to cognitive behavior, affective behavior is a much 'softer' (i.e., harder to define) type of behavior with the result that the development of the affective taxonomy was a rather difficult task. It was hard to define exact categories of behavior that had definable boundaries; the categories seemed fuzzy and blurred rather than crisp and focused, as was the case for the cognitive categories. Eventually Krathwohl et al. defined five major categories which, in order of increasing complexity (called Degrees of Internalization) were: Receiving, Responding, Valuing, Organization, and Characterization by a Value or Value Complex. Each of these categories was characterized by the set of behaviors exhibited by a person operating in the category. Because the affective domain is rather fuzzy, the affective taxonomy has never enjoyed the wide spread acceptance given to the cognitive taxonomy.

The last pages of the material in Appendix A address the affective domain. You will find general material for the first three Degrees of Internalization. Only the first three Degrees of Internalization are discussed since the final two degrees are not considered by the author to be appropriate for use in the university classroom setting. These top two degrees involve the integration of the value of learning and material learned into your personal value structure, a structure that encompasses much more than educational values; thus movement to these higher degrees of affective behavior must take place outside the classroom, in the broader context of your life.

---

[4] *Total Quality Learning Handbook*, Langford Quality Education, 1992

[5] *Quality Management in Education*, and *Total Quality Management in Schools of Business and of Engineering*, Myron Tribus, Exergy, Inc., Hayward, CA

[6] *Taxonomy of Educational Objectives Book 2 Affective Domain*, David Krathwohl et al, Longman, 1964.

Psychomotor Domain

The last piece of the educational state is defined by your psychomotor skills and abilities. As of this writing there has been no definitive taxonomy developed for these attributes; therefore, you will not be expected to evaluate this part of your educational state.

This Guide

The remainder of the material in this guide is organized into three parts and a set of appendices. Part II discuss expectations concerning the presentation of your work. Part III introduces the mechanics of creating and using the portfolio. Part IV is a more detailed discussion of the assessment process and attempts to explain the steps in more depth. If you have never used a Portfolio or Competency Matrix you will want to read the first part of Part II and all of Part III, and do the work suggested. Once you have a general understanding of what is expected you will want to read Part IV to get a better understanding of the process and improve your process.

Part II -- Presentation of Technical Work

Before discussing how to organize and assess your work it is necessary to generate and present some work. You have, of course, had experience in this area[7]; however, I am sure you have had situations where the evaluation of your submitted work was lower than expected in part because the work, while technically correct, was not presented well (in the eyes of the teacher). Your ability, and that of others, to assess your work depends, to a large extent, on how you choose to present (i.e., document) your work. A large part of the evaluation process is directly related to the quality of the presentation, which is related to the evaluator's expectations. It is necessary that you realize what is expected so that you can supply it.

This portion of the guide presents some general traits of quality presentations and then addresses some specific presentation issues.

General Presentation Traits

While specific expectations for presentations vary depending on what sort of task you are documenting or who is reading (evaluating) the material, there are some general, philosophical guidelines, that can help you achieve a good presentation (documentation) of your work. Initially, these traits may seem to require extra work and be solely associated with a desire to make the work understandable to someone other than yourself. Upon reflection, however, you will realize that this work is not really extra. When you do the *extra* work required to make the work understandable (i.e., presentable) to other people, you actually achieve a better understanding of what you have done (are doing) and with this understanding comes the knowledge of how to do the work even better than you first envisioned. It is hard to consider anything that allows you to do your work better to be considered as *extra* work.

When presenting your technical work, here are some traits you should strive to achieve:

1. explain what is going on

   You should attempt to let the reader know, at all times, what is going on. This means explaining what is being attempted, why it is being attempted, and what method is being used. This also means that at the conclusion of a task you explain the consequences or meaning of what you have just done.

2. make explanations clear

   Trait #1 addresses the need to explain what is going on; this second trait involves making explanations clear (i.e., reducing the variation in interpretation). Clarity is often enhanced by using sketches, plots, figures, or some other type of graphical presentation to augment the text. Clarity is also improved when terms and variables are defined.

3. make it readable

   If you make the work easier to read you will improve the presentation. Explaining clearly what is going on improves readability. Other ways to improve readability include providing neat work, clean sketches, binding the material so that it does not fall apart and yet is easy to access, numbering the pages, etc.

4. make it clear whose work it is

   It should always be clear who did the work and when the work was done. This is usually done by dating and initialing each sheet of the work product.

You should strive to incorporate these **traits** into all your presentation efforts; omitting even one of the traits reduces your ability to produce an adequate presentation.

---

[7] During high school and college you have done homework, generated reports, etc. that were submitted to a teacher for evaluation (grading).

Presentation of Technical Work

Presentation Expectations for Some Types of Technical Work

There are clearly many different types of work to be documented and no attempt will be made here to address all these types. Rather, the expectations for a few types of work, work that you will encounter in your engineering classes, will be discussed. Homework, plots, computer models, and other work products will be discussed. If this is your first time through the guide you may want to skip the material on models and come back to it at a later time.

Homework

You have homework in every engineering class that you take. While you will find that the format for homework (e.g., the size of the margins, the order in which material is presented, the way results are presented, etc.) will vary from class to class, you will also find that the expectations for what is presented will not vary significantly from class to class.

When the general traits of good presentation are applied to your homework, the following set of expectations emerge.

1. State The Problem

   Write down the problem statement as it is given in the book or assignment sheet. This sets the context for the problem and the work (addresses general trait #1).

2. Draw An Appropriate Diagram Or Sketch

   The diagram should show the information given in the problem and show what is required or desired. Thus, if the problem were to determine how much force it would take to lift a safe using a lever and fulcrum (pivot), then your diagram would show the lever, the fulcrum, the safe, and you pushing down on the lever (addresses general trait #2).

3. Describe Your Process of Analysis

   Describe in a few sentences what process, methods, and approaches you used in analyzing the problem. You should include any assumptions you have made. For example, in the safe/lever problem, you might report that you are going to use a force balance (or equilibrium). This should be more detailed than just stating a general name (e.g., force balance); you should describe a few of the key steps in the named process (addresses general trait #2).

4. Perform the Analysis

   For the process described in 3 above, work the problem. Working the problem includes documentation of your analysis, including all appropriate intermediate results. Note that documentation of the analysis process (working the problem) is as important as the final result (sometimes known as *the answer*) obtained from the analysis.

5. Discuss the Results of Your Analysis

   You must contemplate or reflect on your results and present some comments about the results. What do the results mean? Is the result bigger (smaller) than expected? Is the result reasonable? What might be done next? These are only a few of the possible questions you could address when you are writing your discussion of the result (addresses general trait #1).

   If your work has created a plot or a table of figures then you **must** discuss each of the plots or tables. What is the trend? Can you extrapolate?

When you prepare your homework for this or any other engineering class, you are **expected** to adhere to these five points. Failure to follow anyone of these points means that you are not meeting the expectations of most faculty (and as you will see later, not meeting your own presentation expectations).

Graphical Material (including plots)

A considerable amount of information is contained in pictures; hence, your work will often contain significant amounts of graphic information (general trait #2). This graphic material is generally either pictures of an artifact or plots showing the relationships among some variables. Because pictures contain so much information concisely (i.e., pictures capture the essence of the material) graphic material is frequently copied and distributed, often without the accompanying text. Since this practice is so ubiquitous, it is critical, when preparing graphic material, that you:

1. add enough annotation to the material that the picture makes sense standing alone, and
2. prepare the graphical material so that it can be reproduced.

This means that you must include **titles** and **labels** on all your graphic material, and you do not put your drawings on green grid graph paper using a number 3 pencil.

Aside from these two general items, there are some standard expectations concerning the presentation of plots that you will want to be aware of and follow. These plot expectations are:

1. Both **axes** of a plot must be labeled, including units when appropriate. The use of only a variable (e.g., V) as the label is discouraged because of the different interpretations (e.g., is V volume, velocity, etc.). Using only variables as labels is not in keeping with general trait #2.
2. The **divisions** for each axis must be marked. The value the plot *origin* (intersection point of axes) must be clear.
3. The **dependent variable** (the variable **calculated**) is always plotted on the **vertical** (y) axis while the independent variable (the variable you **changed**) is plotted on the horizontal (x) axis. This expectation has ramifications concerning plot titles (see item 4).
4. The plot must have a **descriptive title**, including a Plot or Figure number. The title *P vs T* is not considered to be descriptive and must be replaced with something like *Container Pressure as a Function of the Internal Tank Temperature*. The title should list the **dependent variable first** and the **independent variable second**. For example, if the title is *Production Flow rate vs Compressor Discharge Pressure*, you know that the discharge pressure (mentioned second) is the independent variable and is shown along the horizontal axis while the flow rate (mentioned first) is the dependent variable, plotted along the vertical axis.
5. If you are displaying a number of related curves on the same plot you need to have a concise **legend** defining the various curves.
6. Data points used in generating the plot are generally shown.
7. Smooth curves are generally drawn through or near the data points to show the trend.

The above expectations are true for any plot, whether it is hand or computer drawn, found in your homework or in a report. You may find that computer drawn plots do not meet some of these annotation standards. In such cases it is entirely permissible to add the annotation after the plot has been generated. You can add this annotation by hand, with a typewriter, or transfers.

Analytical Models[8]

Models play a significant role in engineering and it is very important that you realize what is expected when presenting your work. The material that follows is divided into three major areas: **first,** how to present the work related to the development of the model; **second**, what is expected concerning the model itself; **third**, presenting the work related to the use of the model.

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[8] This material makes sense only after you have some idea of what analytical models are. If you do not have this knowledge then skip this section and come back later after you start building and using analytical models.

analytical model development

What is expected for **analytical** model development follows directly from the general traits. Analytical model development concerns all aspects of assembling the set of equations that are used to predict performance. After reading the model development material it is expected that the reader will believe that the work is complete and correct. It is expected that all model development work will:

1. define the system being modeled (general trait #1 & 2),
2. define the model limitations (general trait # 1),
3. define the model variables (general trait #2),
4. establish the appropriateness of the modeling method (general trait #1), and
5. establish the correctness of the model's results (general trait #1).

The first three items are relatively straight forward and probably reflect the sorts of definitions you have already been including in your presentations. However, the fourth item may not currently be part of your presentations. For homework problems the appropriateness of the modeling method is often assumed (implicit and not stated); why else would the assignment have been given. Even so, it is important to address this issue when presenting model development. There are several ways to establish the appropriateness of your model. You can cite experts. You can also construct the model from basic principles of science and mathematics. Appropriateness also requires addressing whether you have the necessary resources (time, money, computer power, expertise, etc.) to implement the model; i.e., applying Occam's razor.

The last item is an issue you may or may not have explicitly addressed to date. It is expected that you will present work to show that the model is actually working correctly (i.e., that there are no errors in the model). This is not a trivial task and there are a variety ways you can show that your model is working correctly, each with a different degree of credibility. Probably the best way to show model correctness is to run your model with a test case that has known results (e.g., run a homework problem from a text book). If this is not possible the next best method would be to show that the model generates results (designs) similar to existing designs (e.g., the models predict rocket nozzle sizes of the same size as those found in industry). Next might be to show that the model *behaves* correctly (i.e., when inputs are changed the outputs change in the predicted fashion). Some confidence in model correctness can be obtained by showing that the model generates correct order of magnitude answers. Probably the method least likely to convince, although it does provide some evidence of model correctness, is to show that the model reproduces the results of some earlier paper and pencil work.

computer models

The above discussion applies to any model that is developed, independent of the method or tools used in **running** the model. When developing computer models there are some additional documentation expectations that help assure that the computer model is understandable and correct.

high level languages

If the model is developed using a high level language such as C, the computer code must include comments and a variable dictionary. A listing of the program must be included. The listing should be easy to read (i.e., not bound into the documentation in such a manner as to make reading impossible). Any model that exceeds several hundred lines of code should be broken up into a set of smaller subroutines or procedures with an accompanying flowchart to explain the general program logic and control.

equation solvers

If the model is developed using an equation solving program such as TK then the documentation must include a completed Variable Sheet[9] including the Units and Comments Columns. The Variable Sheet must show a consistent set of values for **all** variables. You must also supply a copy of the Rule (Equation) Sheet. The Rule Sheet should contain some general comments to tie major sets of equations together. There must be enough annotation on the Rule Sheet to explain the basis for the various equations or sets of related equations. If the model uses any special user defined functions these should also be included in the material submitted. User functions should be documented in the same fashion as the equations on the Rule Sheet.

spreadsheets

Documenting a model using a spreadsheet may be more difficult than using high level languages or equation solvers because spreadsheet equations use cell addresses rather than variable names. This problem has been partially ameliorated by including the ability to name single cells in a spreadsheet. Names assigned to single cells may be used in the formulas in place of absolute cell addresses. Arrays may also be assigned names but **individual** elements of the array may **not** be addressed with the name. However, the array name may be used in built-in functions in place of the range. In spreadsheets, a clearly defined title or heading must be assigned to **each** column and/or row of the sheet and it may be appropriate to use an adjacent cell to identify or label the contents of an individual cell. If the equations in the spreadsheet are not *intuitively obvious,* then you should append a report that explains what calculation is being performed in each cell. The report may be appended using the 'cell notes' feature of most spreadsheets.

In developing a spreadsheet model, there are some matters to consider which will generally lead to a robust, easily maintained, quality model. In particular:

1. Start with a plan. Sketch out what the spreadsheet is going to look like on paper.
2. Keep data entry and calculation areas separate. If the sheet has numerous inputs or data, you may want to have an entire screen reserved for the inputs or data.
3. Use the paper sketch above to construct the actual spreadsheet.
4. Concentrate the entry of your inputs or data in one area or block. Arrange the inputs or data in contiguous cells (i.e., sequential rows in a few columns, or sequential columns in a few rows).
5. Do **not** use **numerical values** for "design constants or parameters" in your formulae. Use cell references and assign names to the cells containing the current numerical values of these "design constants or parameters". This will allow you to change these values without changing the formulae. For example, enter the numerical value for the time step in a cell and use this cell reference or name in your formula for calculating time.
6. Separate, decompose, or parse large or complex calculations into a set of smaller or simpler calculations. Place the smaller or simpler calculations in adjacent or contiguous cells in the sheet.
7. Always test, validate, or calibrate your spread sheet (see item 5 under model development).
8. Use cell protection for protection and highlighting of areas that contain formulae or other information that will not be changed frequently.
9. Use column and row labels as well as cell labels extensively. Include operating instructions for the sheet (text boxes may be used for these instructions). In summary, clearly and completely annotate your spreadsheet model.
10. Use the cell and sheet formatting features found in most modern spreadsheets to improve the appearance and presentation of your model.

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[9] Equation solving programs have a variety of input and output screens which they call sheets. Some of these programs can solve multiple cases by running in what is called *List Solving*.

11. Back up your files FREQUENTLY! And maintain at **least two** copies of the files on **separate** diskettes! This may feel like a tedious, unnecessary, or even unproductive task but the first time your files are damaged or lost you will value this task immediately!

the use of models

Once a model has been developed and validated (or calibrated, or shown to be correct, or tested, etc.), you will be using the model to assist you in understanding some system or making decisions based on your model. You may use the model one or two times, or in some instances, you may use the model a great many times (i.e., you will execute the model for a number of design cases). It is easy to be overwhelmed by the enormity of data that can be generated with a computer model, and the presentation of this work needs careful consideration; in particular, how to display the results of all these runs and how to discuss the results of the runs.

displaying the results

The important results of any case, such as those used to substantiate a conclusion, can be displayed using plots and or tables. Tables are generally required for any plot shown; however, there is no need to generate plots for all the tabular data; only the most important relationships need to be plotted. The data from all cases that are run using the same model (i.e., the equations are not changed from run to run; only the input data are changed) should be grouped together in some logical order (chronological, variable changed from case to case, etc.).

It is important that the numerical values of **all** the variables be known for **each** case or run. Generally you will have a large set of result variables that are not changed for any of the cases and a smaller set of variables that are changed from case to case or run to run. A listing of the variables which are held constant during a case or run, and their numerical values, needs to precede the case results. For each case that you run, you will generate a set of lists, probably collected into a table, showing how the result variables changed. For each case, you must annotate the lists or tables of results with an explanation of what has changed from the previous case (i.e., specify the numerical values of the variables that changed for the each case). If you use a general table containing numerous result variables, only some of which are of interest for each case, you must identify or mark the variables of interest (using a highlighting marker is acceptable or you may use formatting in a spreadsheet).

discussing the results

When you present the results of your work you need to explicitly discuss the results (i.e., never submit a plot or a table without some discussion of the table or plot). This written discussion will probably precede the results (the tables or plots). When you develop this discussion you should look at the data and then tell the reader what you want the reader to notice (explicit presentation); do **not** make the reader figure out (i.e., infer) what is important or interesting about the data (implicit presentation). Explain what decisions you have made or will make based on the data. If the data has any anomalies do not ignore them; either attempt to explain why they exist or admit that after consideration you cannot really explain the unusual (unexpected) shape. The discussion must refer to the plots and tables by their names or numbers.

Part III -- Portfolios & Matrices Made Easy

Now that you have work to present how should it be organized? Organizing your work is always important. Organized work is work that can be used again. It can be used to review the semester's work; it can be used to remind you how to do something a year later; it can be used to show someone else what you have done. There are many ways to organize the work (e.g., chronologically, by assignment number, alphabetically, etc.), each appropriate depending on the reason for organizing the work. In this class the goal is to organize the work in a fashion that allows ease of assessment.

This is a three step process. First, an organizing structure must be defined and implemented; second, the work you do must be inserted within the created structure; and third, the index to the work must be updated. The first step is the creation of an empty, but functional, Portfolio; the second step is the filling in of the Portfolio; the third step is the updating of the Competency Matrix. The last two steps are the assessment steps and are the most difficult to do. This part of the guide is meant to make it possible for you to start the assessment process without completely understanding the process. Once you have a general idea of what is expected here read Part IV, which focuses on the assessment process itself. When you read Part IV you will begin the understand more fully the mechanical steps you have been asked to perform in this section.

Creating an Empty Portfolio Structure

The following steps are the process of setting up a Portfolio for a class. An example, using the Competency Matrix shown in Appendix B, is given.

1. Purchase a three ring binder with hard covers that can take standard three hole punched paper The size binder you need will depend on how much work you will be doing during the semester; unless you are instructed differently, a three inch thick binder should be adequate. You should also purchase a number of tabbed page dividers (see item 3 to determine how many dividers you need).
2. Obtain the Competency Matrix for the class from your course instructor (see Appendix B for matrix to be used in the example).
3. Label your page dividers as follows and put them into the binder.
    1. Mark the tab on your first divider **0-competency matrix.**
    2. You now need to create a series of numbered dividers, one for each of the *Learning Outcomes* in your matrix.
        a. Review the Competency Matrix; note that the left hand column is labeled as either *Learning Outcomes* or *Competency Category*. If you note this column on each page of the matrix you will see from one to three (four) different topics listed. Each topic is a learning outcome (competency category) for the course. The matrix shown in Appendix B includes two learning outcomes: *differentiation* and *team meetings*.
        b. Review the entire Competency Matrix and count the number of different learning outcomes. If the number is N then use N more page dividers. For the Appendix B course you would get out two more dividers (i.e., N=2).
        c. Label each of your N divider's tabs with a number and *Learning Outcome*. For the Appendix B course you would have two dividers with tabs labeled as **1-differentiation** and **2-team meetings**.
    3. Label the next divider **N+1 class notes** (for example it would be **3-class notes**)
    4. Label the next divider **N+2 work logs** (for example it would be **4-work logs**)
    5. Label the next divider **N+3 run charts** (for example it would be **5-run charts**)
    6. Label the next divider **N+4 reflection logs** (for example it would be **6-reflection logs**)

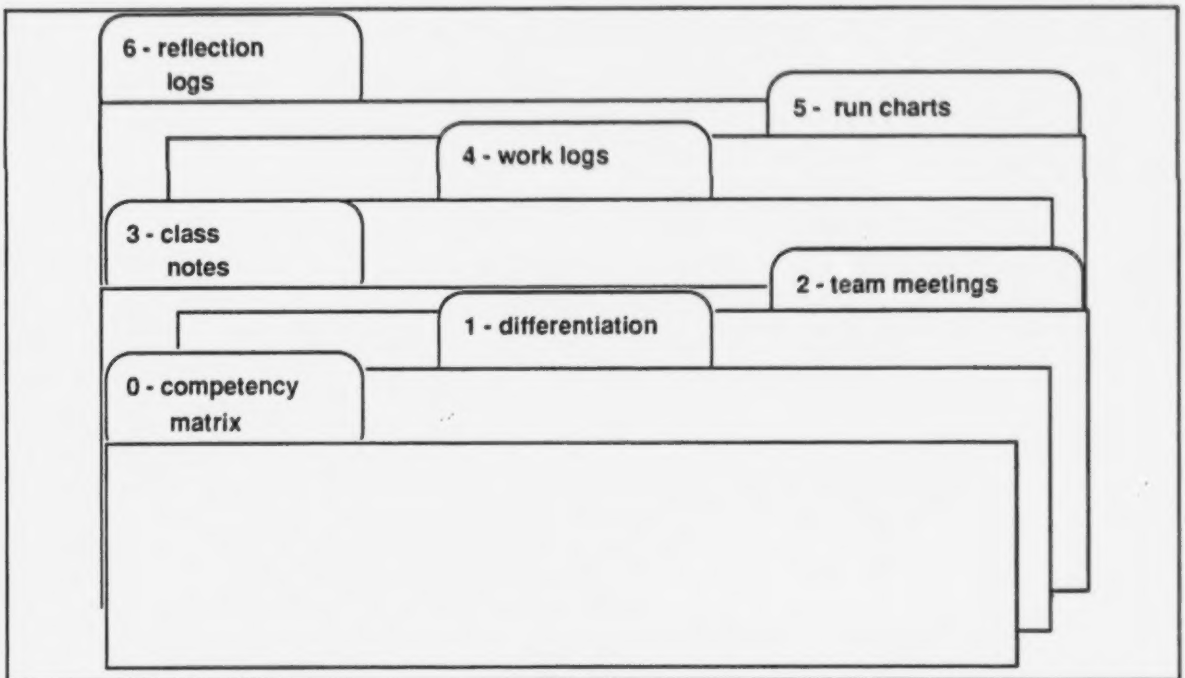

Figure 2
Portfolio Dividers For Example Competency Matrix in Appendix B

4. Punch holes in your competency matrix and insert it behind the first divider.

Your Portfolio is now prepared and ready to use. It has N+5 dividers (counting the divider for the competency matrix), the competency matrix, but no work products as yet. The next section explains how to place your work products into your Portfolio. Figure 2 shows what the dividers would look like for the sample Portfolio for the class using matrix in Appendix B.

Filling the Portfolio

You now have an empty Portfolio ready for your work products. How this might be approached for the class using the matrix in Appendix B. Assume you have been given an assignment at the end of a Section that requires you to differentiate five trigonometric functions, three of which required implicit differentiation, and that you completed the assignment, presenting your work according to the expectations of the course instructor[10]. The question is: Where does this work go?

This question may be answered in one of two ways. First, your instructor may have explicitly told you what Learning Outcome this assignment is related to (e.g., *this assignment involves the Learning Outcome of differentiation*), in which case you now know in which section of the portfolio (i.e., differentiation) to place the work product. On the other hand, if the instructor has not provided this information, you will need to determine the Learning Outcome. To do this you must find the *Learning Outcome* that covers the work and put the work in that section of the Portfolio . In our example, the Competency Matrix shows that there are only two possible *Learning Outcomes*: *differentiation* or team *meetings*. There is little question that this work product is associated with *differentiation;* thus, the work belongs in Section 1 of the Portfolio.

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[10] This means you have prepared your work according to the expectations for homework discussed in Part II of this guide

This example was relatively easy but what do you do when it is not so clear-cut? The Competency Matrix can help you decide if a particular *Learning Outcome* is related to the work product. In your Competency Matrix the *Learning Outcomes* are further defined as rows within the *Learning Outcome*. In our example, the course learning outcome *differentiation* is meant to include five things (exponential functions, hyperbolic functions, implicit (differentiation), polynomials, and trigonometric functions). For our example, this break down shows even more clearly that the work just completed truly is associated with the first outcome and belongs in Section 1 of the Portfolio.

Before you punch holes in the work and insert it into the Portfolio you need to add some page numbers. If this is the first work done in the section, then number the pages 1.1, 1.2, ..., 1.9 (assuming the assignment was nine pages long). If there is already work in the section find the last page number and start with the next number for this new work. Thus, if the last page number were 1.45, you would number this latest work as 1.46, 1.47,..., 1.54. Notice that the page number includes both the section number (1) as well as the page number (45, etc.). Once the page numbers have been affixed to the work, punch three holes in the work and add it to your Portfolio.

Problems in Determining the Portfolio Section

The process just discussed is reasonably straight forward; however, questions do arise. Below are two common questions with some suggested solutions.

1. *I cannot find a Learning Outcome that is associated with the work I have just done*

   You need to look again, more closely, at the Competency Categories (the rows in the matrix) to make sure there are no rows addressing the work product. If you cannot find any row that you feel is related to your work product, you need to discuss this with the course instructor. You either do not understand what some of the rows actually mean or you have done work beyond what was expected by the course instructor.

2. *The work I have done seems to be associated with more than one section*

   This is not an uncommon situation. You could duplicate the work product and put copies of the work in each appropriate section, but this is not really needed or desirable. You should select one section and put the work product in that section. There is no fundamentally correct way of selecting the section but you might consider putting the work product in the section that has the most matrix rows addressed by the work product.

Now you have a Portfolio containing appropriately prepared and presented work products; however, but you still have not created the index, the last step and the subject of the next section.

Building the Index

This is the most difficult part of the process. You need to enter on your Competency Matrix the page numbers of the work products you have just placed in the portfolio. Where in the Matrix do these page numbers go?

This question is already partially answered. To determine where in the Portfolio to put your work products you had to decide on a *Learning Outcome* and probably the rows within the *Outcome* associated with the work. Thus, for our example, we know the matrix rows of interest are rows 1.3, and 1.5 (implicit, trigonometric functions). The question now is where along the row (i.e., in which matrix box) do you enter the page numbers?

This question may be answered explicitly by the course instructor (e.g., *This work, when done correctly, shows Comprehension for implicit and trigonometric functions*) in which case you would enter page number 1.46 (the starting page number for the new work) into the matrix boxes located at the intersection of rows 1.3, and 1.5 and Comprehension column.

When the instructor does not tell you the matrix location for the work you must determine this for yourself, which is the start of the self assessment process. To determine the matrix location you must understand the meaning of the nine columns under the Affective and Cognitive titles and the distinctions between them. As pointed out in Part I these columns represent increasing levels of understanding (cognitive columns) and interest or attitude (affective columns). Some of the characteristics or traits of work done at each of these levels is given in Appendix A to help you make this decision.

Once you begin to understand these definitions, the question of which box to put the page numbers in can be answered: You put the page numbers in the box under the highest level of understanding or interest justified by the work as presented in the Portfolio[11]. In our example, after reading the discussions in Appendix A, it seems reasonable that the work shows Responding and Comprehension (both of these levels apply to working homework type problems) and you should put page number 1.46 into the boxes at the intersection of rows 1.3, and 1.5 and the Responding and Comprehension columns.

Problems in Determining the Appropriate Matrix Column

This process takes some practice and you will need guidance from your course instructor. Here are some common questions with some possible solutions.

1. *When I look at my work and at the definitions of the levels and degrees in Appendix A, I see some matching at a particular level but the match does not seem to be complete*

   This will occur frequently. The material in the Appendix is rather broad and covers a number of different ways (activities) that show you are operating at the level of interest. It is not expected that your work will match all aspects of these definitions.

2. *It seems to me that I have matches in several different levels or degrees, which one should I claim?*

   This will occur rather frequently. The levels and degrees are based on taxonomies[12] which means the higher levels and degrees grow out of or upon the lower levels and degrees. You will find that the difference between the upper and lower levels and degrees is generally the environment within which you did the work[13] or how you present your work rather than the work product itself. When two levels are possible you should always choose the lower level if it has not already been documented (i.e., you have not already placed a page number in the lower box) and the higher level if the lower level has already been documented.

3. *I think that I have been working at a high level but when I look at the work in the Portfolio I do not think it really shows that I am working at the high level.*

   This will happen and must be addressed. First, you can discuss this with the course instructor; she may be willing to accept an oral demonstration and let you put the page number of the work product that does not really show the high level in the high level box. An alternative is to add to your presentation of work so that the presented work does show that you were working at the high level.

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[11] The **as presented** is important because for assessment it is only the work present in the Portfolio that can be used to establish the appropriate level.

[12] The systematic distinguishing, ordering and naming of type groups within a subject field, *Webster's Third New International Dictionary*

[13] For example, how much were you told about how to do the work and how much did you have to gin up yourself.

What Now?

When you created your portfolio structure you were asked to create several sections that have not yet been addressed. The section on Class notes is self explanatory but what about the others (Work Logs, Run Charts, Reflection Logs)? Should you be putting material into these sections? These are discussed in the next Part of this guide. If your course instructor asks you to keep Work Logs or Run Charts, you will need to read about them in Part IV. You will not initially be asked to create Reflection Logs and so you do not need to worry about them at this time.

After you have experienced the process of preparing work products and entering those products into your Portfolio a few times, you will then find it worthwhile to read Part IV to get a more in depth coverage of this evaluation process.

Part IV -- Self Evaluation Process

The concept of an educational state was introduced in Part I; an introduction to a method that could be used to document (verify, show) that you have reached some educational state was presented in Part III. Now it is time to better understand the assessment process so you can master the self evaluation process.

Two important questions need to be answered with regard to assessment:

> *How do I know when I have reached some educational state? and*
>
> *What do I have to do to show myself or someone else that I have indeed reached this educational state?*

When you become an expert at self evaluation you can, and will, fairly and correctly evaluate your actual educational state with little more than internal (i.e., in your brain) evidence. But this type of *psychic* evidence will not be acceptable for classes or other situations where you must show others that you have reached a claimed educational state. In these situations you must supply **documentation** (information presented in some appropriate form) that **demonstrates** (shows) to the satisfaction of the reader that you have actually reached the educational states you are claiming. Even in those situations where you are doing only self evaluation, the preparation and presentation of this documentation generally leads to a fuller understanding of the material (see General Presentation Traits in Part II).

Before discussing the evaluation process it is necessary to understand the various documentation instruments (methods) that are used in the evaluation process; therefore, these instruments are discussed first, followed by a discussion of the process.

Documentation Instruments

The documentation process uses several different instruments (methods) for recording and storing your work. You must understand what each of these instruments is used for and how to use them before you can effectively produce them.

A Portfolio (or Design Notebook)

A portfolio is an organized collection of your work, technical and *non technical*, prepared for a particular class. It contains, in some logical sequence, all your out of class work, quizzes, tests, reports, projects, reflection and work logs (see below), class notes (optional); that is, everything done during the semester that relates to the class. Your portfolio becomes a collection of worked examples, examples you can refer to in later classes (or when out of school) when you need to review a topic learned in an earlier class.

Physically, portfolios are three hole, loose leaf binders, although accordion files can also be used. Loose leaf binders (as opposed to other binders) are recommended since it is possible to remove and/or insert material, a necessary capability. The number and order of the sections in the portfolio is not mandatory; however, the following suggested organization should help if you are not sure how to start. Note, you may not understand what some of following sections are until you read on but once you do understand, you will then know where to put them.

Table 1 on the next page shows a suggested organization for your portfolio. As you can see the number of sections is not fixed, rather they are a function of the Competency Matrix associated with the course. Once you understand your Competency Matrix you should be able to find a location (i.e., an appropriate section) in the portfolio for all of your work products.

The work within a section should also be organized so that you can easily find it. To this end you will need to number all the pages of your work. Your page numbering must be unique (i.e., no two pages can have identical page numbers). This is probably most easily accomplished by using a numbering scheme that includes the section and location with in section (e.g., 1.2 is page two within section 1).

A design notebook is a special type of portfolio, one containing all the technical work related to a design project. Since design projects are often done by teams, the design notebook will include work from a variety of people. The sections in a design notebook will not be Learning Outcomes but rather separate technical tasks that are undertaken during the design process. Thus, for example, you could have sections related to Circuit Analysis, Structural Analysis, Propulsion, etc.

All the technical work in the portfolio/notebook must to the adhere to the expectations for presentation of technical work presented in Part II.

Competency Matrix

In any class the instructor has a set of knowledge and skills (e.g., Engineering Design Process, Second Order Differential Equations, First Law of Thermodynamics, Teaming, etc.) that she wants to have the class learn. This set of knowledge and skills are known as the l*earning outcomes* for the class. Learning outcomes are generally rather abstract and must be characterized by (i.e., defined in terms of) a number of more specific topics called *competency categories*. Depending on how specific the competency categories are, it may be possible (desirable) to further divide these competency categories.

However, it is not enough to define the learning outcomes and competency categories; the instructor must also decide, for each of these items, what cognitive and affective behavior levels the students should achieve. This collection of concepts to be learned and the levels at which they are to be learned can be organized and presented in a Competency Matrix.

The general design of the matrix is quite simple. Along the left side of the matrix are the general course Learning Outcomes (sections in portfolio) along with each Outcomes' more specific Competency Categories (and Sub-categories if they exist). Along the top of the matrix are the various affective and cognitive behavior levels. Each cell in the matrix represents the intersection of a particular competency category or learning outcome and a particular cognitive level or affective degree. Part of a Competency Matrix for a Calculus Class is shown in Appendix B.

Note that the Competency Matrix includes black dots, gray areas, and white areas. The black dots show the cognitive and affective performance you are **assumed** to have reached when you start the class. The gray areas are the cognitive and affective performances that you are expected to achieve during the course of the semester. The white areas represent the cognitive and affective performance you may achieve, but are **not** those explicitly expected to be achieved in the particular class.

At the start of a semester your matrix is empty. During the semester you will make entries in each of the gray (and perhaps white) boxes in the matrix. These entries are pointers to work products in your portfolio that you feel support your claim of being at the specific educational state. The Documentation Process Section (see below) describes the information that should be noted in these boxes.

As a vehicle for documenting your educational state you will find that the matrix serves two purposes.

Section Number	Content
0	Course Competency Matrix
1	First Learning Outcome in Competency Matrix
.	.
.	.
.	.
N	Last of N Learning Outcome in Competency Matrix
N + 1	Class Notes
N + 2	Work Logs
N + 3	Run Charts
N + 4	Reflection Logs

Table 1
Suggest Portfolio Organization

1. It indicates the cognitive and/or affective performance you have achieved in each of the course's competency categories, and
2. it indicates the location of the technical work which supports the claimed educational state.

Work Logs

Work logs, as the name implies, document the time spent preparing the work products you have prepared during the semester (i.e., the time spent on various class related tasks) . A sample work log template is shown in Appendix B. The log contains factual information related to your work. The log tells when the work was done, how much time was spent on the work, where the work is located in the Portfolio, and finally a code that clarifies the type of work performed.

Run Charts

It is sometimes necessary to monitor, over time, a quantity whose value changes with time (e.g., the outdoor temperature). In such situations it is often useful to present not only the current value of the quantity (e.g., temperature right now) but also the running, time averaged value of the quantity (e.g., average temperature over the last six hours). The name Run Chart comes from this type of presentation where you present the *running* history of the quantity's value. The time changing values can be periodically entered into tables. However, trends are hard to see in tables; therefore, this data is generally also shown on a graph, known as a Run Chart. A run chart is just a graph or plot that has time as the horizontal axis, and the value of the time varying quantity on the vertical axis. The chart or plot must show the instantaneous values as well as the time averaged value. Generally the time averaged value will be shown as a curve superimposed on the instantaneous values.

A sample Class Attendance Run Chart that might be used as a general demonstration of Responding in a class, is shown in Appendix B. The chart shows time along the horizontal axis (i.e., class number) and the value of attendance along the vertical axes (yes = 1, no = 0). The data for each class is shown by the height of the bar while the running average is shown by the line. In the example shown the person missed class on the 3rd, 5th, and 11th day (bar has zero height). For the third class the running average dropped from 1 (perfect attendance) to 0.67 (attendance for two of three classes). The running average drops for each class not attended and slowly rises when classes are attended. You can see that the running average after twenty classes is about .86.

Reflection Logs

The last of the documentation tools are the Reflection Logs. These are the most difficult documents to produce and should only be attempted after you feel very comfortable with the evaluation process. In fact, the ability to create these logs is really a *final test* to demonstrate that you really are able to do evaluation. Why are these logs so difficult to create?

The work contained in your portfolio displays activities you have undertaken during the semester. Some of this material shows Comprehension activities, some shows Evaluation performance, some shows Valuing behavior, etc. Traditionally, it has been the course instructor's task to sort through the work and decide what educational state was shown by the work. Determining the educational state was done by (mentally) comparing the work with a set of Standards (Exemplars [14]) to decide which Standard (Exemplar) the work most closely matched.

In the self evaluation mode, this task of matching work to performance Exemplars is done by you. You must look at the work, as presented in the portfolio, and select the most appropriate educational state Exemplar. Once you have completed this mental comparison and selection (i.e., this reflection on the presented work) you are ready to write a Reflection Log (see Appendix B for a template) which is a written explanation of why you selected a particular Exemplar. Such logs will contain traits from the selected Exemplar that you observed in the presented work. The logs often also show why the work is not a member of other possible Exemplars. These logs are meant to be informative, describing how you determined the educational state. When well written, they will be persuasive, convincing other individuals that you do understand the evaluation process for the educational state selected.

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[14] Exemplar - that which serves as a pattern, especially an ideal pattern

The log need not look like the template shown in Appendix B, but it should contain the same information. The log must have an identifying entry number and it must be clear which competency category (i.e., row(s) in the Competency Matrix) and Level of Learning and/or Degree of Internalization (i.e., columns in the Competency Matrix) are being addressed. Additionally, it must be clear where in the Portfolio the technical work being discussed is located. Finally, the log must contain the paragraph(s) of reflection. You may find that the reflections require more space than is given on the form, in which case you can append the necessary additional pages to the log entry.

The Self Evaluation Process

Now that you are familiar with the various documentation instruments it is possible to discuss the process that will let you complete your Competency Matrix (i.e., let you fill in each gray box). This section describes a general, self evaluation process, along with two slightly different implementations of the process.

The general self evaluation process consists of the following six steps:

1. generate and present evidence of activities or abilities,
2. compare your evidence to a set of Abilities or Activities Exemplars defined using a predefined hierarchy of learning,
3. select the Exemplar that best fits your evidence,
4. explain how the selected Exemplar defines your current educational state,
5. explain your Exemplar selection process, and
6. fill in the gray boxes in the Competency Matrix.

Details about step 1, steps 2, 3, and 4, taken together, and steps 5 and 6 follow.

Generating and Presenting Evidence (step 1)

Before steps 2, 3, and 4 of this process can be completed there must be activity and memorialization of the activity. Thus, the first step in documenting your educational state is the generation, collection, and presentation of evidence that can be used to show that you have indeed reached a particular educational state. The specific work product you decide to produce (i.e., the problems you solve, the way you solve them, and the way you present them) is influenced by the motivation you have for doing the work. Several different motivations are possible. **First**, the work may be motivated strictly by your desire to have examples showing that you are at some educational state (e.g., doing out of class assignments assigned by the class instructor). **Second**, the work may be generated strictly because you are solving a self-generated, technical problem that you have an interest (need) in solving (e.g., working on a design project). **Third**, the motivation may be a combination of these two (i.e., working to solve self-generated problems and, incidentally, also using the work to show achievement of some educational state).

For courses that are **not** project intensive, most of the work done in the class is done for the first reason, generation of examples showing that you have *learned*[15] the material. This sounds reasonable; however, few assignments include a notation explaining which gray boxes in a competency matrix should be marked to show that the assignment illustrates mastery of a competency category Generally an assignment will indicate mastery of several competency categories; with a little imagination, most assignments can be used for a wide variety of competency categories and several different levels or degrees. You can do an assignment to show Knowledge or Analysis depending on how you choose to perform and present the work.

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[15] achieved some cognitive and/or affective behavior level

Self Evaluation Process

Learning to map assignment to matrix and matrix to assignment (i.e., learning to recognize the learning potential in an assignment) is not necessarily intuitive and takes some skill and thought. When you are first learning how to do self evaluation, the course instructor will discuss with you how her assignments are related to the matrix and what gray boxes you could reasonably use. As you gain familiarity and skill at doing self assessment you will find the course instructor will tell you less and less, letting you do more of the determination of the assignment's potential. You should eventually reach a point where you actually *mold* the assignment to make it fit your immediate matrix needs.

For project intensive courses the work performed is primarily of the second kind, i.e., self generated problems, presented according to expected standards, and located in a Design Notebook. However, since the work is part of a course with specified educational states (gray boxes), some of the technical project work will also be proof of achieving these specified states. You will find that, for some of the educational states you are striving to demonstrate, the standard ('vanilla') notebook presentation of the technical work is not sufficient; the 'vanilla' presentation fails to show the educational state at which you were actually operating. It is relatively easy to present work that actually requires critical thinking (Analysis, Synthesis, Evaluation Levels of Learning) in a form that looks like Comprehension. In such cases you will need to augment the standard ('vanilla') presentation so the work more clearly reflects the educational state at which you were really working.

Exemplar Selection (steps 2, 3, and 4)

The Exemplars you are to use in steps 2, 3, and 4 are the various Levels of Learning and Degrees of Internalization defined by the two educational objectives taxonomies. You are to use the write-ups found in Appendix A as the *definitions* of these behavior states. The task of selecting the appropriate Exemplar consists of reading the various definitions and descriptions of activities associated with each Exemplar and comparing these activities with the activities that have been presented in the previous generation step.

For example, suppose you were in a Calculus class, working assigned, single concept problems, located at the end of a section concerning instantaneous velocity; what educational state does this type of activity suggest? Consider the cognitive domain first. Appendix A shows that for Knowledge, you would be expected to: define terms, read material, take simple recall quizzes. None of these activities seem to match what you have been doing. Reviewing the next Exemplar, Comprehension, you see descriptions such as: work assignments in which the appropriate approach is evident, describe the results of working a problem, restate an idea in your own words. You also see that a typical work product is well presented homework. This seems to be a better description of your work; at least there are some matches (e.g., worked problem, discussed results). However, before selecting this Exemplar you should consider the next higher one, Application. Here you see that the activities are similar to those of Comprehension with the major difference being the source of the solution method used is not immediately evident. You must now decide whether the method you used in solving the problem was *given* to you or whether you remembered the method from some other source or time. Problems at the end of chapters and sections are almost always of the first type; thus, it seems clear that this work is evidence of working at the Comprehension level for competency categories associated with instantaneous velocity.

What about the affective domain? The process is identical. Consider the lowest degree, Receiving. Appendix A illustrates that at Receiving you: listen, read, make notes of topics or items contained in the lecture, reading or classroom activity. This does not sound like what you have been doing; it is too passive. You have been *doing*. Reviewing the next degree Responding, you see: calculating, answering questions in class, working instructor assigned problems. This seems promising; again there is at least a partial match between what you did and the list of possible activities (i.e., doing assigned work). Reviewing Valuing, you see that at this degree you: believe the ideas of instantaneous velocity helps solve problems, can justify this belief, and are concerned when people express skepticism about instantaneous velocity. This Exemplar is possible and you will have to determine whether you are just responding or have developed a value for the material. A Calculus Course is likely to be your introduction to the concept and you probably will not have developed any of the characteristics associated with Value (i.e., you are at the Responding educational state).

As another example, suppose you have created a report that explains the process you used in designing a bridge for a team design project. What cognitive level for failure analysis might this report and accompanying technical work support? A quick review of the lower cognitive levels shows partial matches for Comprehension and Application with Application seeming to be the best choice since you were not told exactly how to design the bridge and so had to recognize the utility of the solution methods you used. Reviewing the Analysis Exemplar, you see: able to break into parts, able to explain why the process works, able to explain causal relationships among the parts. You also see that the typical work product includes a report and in reading your report you recognize traits that match some of these things (e.g., breaking problem up into logical parts for studying different failure mechanisms). Review the next Exemplar, Synthesis, where you see: put together parts, create a report or a process. Again, the material presented in the report shows at least a partial match, you have created the analysis process you used and, further, have explained this process in a report that you also created. So Synthesis is shown; is Evaluation justified? Reviewing Evaluation you see activities such as: compare, choose, evaluate, criteria, etc. If you considered several, different, analysis methods and selected one of the methods based on a rational set of criteria, then you are operating at this top level; if you did not compare several methods but rather created a single method, then it would seem you were at the Synthesis and not Evaluation level for failure analysis.

Note: the decision about the higher levels of learning was based heavily on what **was** and **was not** in the report that tied the technical work together, and not so much on the presentation of the technical work. It is entirely possible that if you were to only present the technical work, the only conclusion you could reach about the level of learning shown would be Comprehension.

It is difficult to determine the appropriate affective degree; you must read the descriptions and decide which is appropriate. It will be either Responding or Valuing; however, which it is depends on you. It is possible that, if this project is a Senior Project, you have used these failure analysis methods enough that you do believe they are useful, in which case you are at the Valuing degree. If you do not see them as useful, then you are probably still at the Responding degree.

You can tell from these two, rather brief examples, how you might go about selecting an appropriate Exemplar. These examples also show that the matches between work presented and the various Exemplars will not necessarily be exact. You will have to make some decisions about when there are enough matches to justify the claim.

Explicit Justification of Exemplar Selection (step 5)

You must go through the previous comparison/selection process for every gray box in your Competency Matrix and every piece of work you present, mentally comparing what you did and have presented with the Exemplars. Initially, because self evaluation is a new to you and because you are not familiar with the Exemplars, this process will take time and you may not do it correctly. In most cases, during these learning stages of the process, your course instructor will tell you what Exemplar is possible when you work a problem. In this case your task becomes one of making sure your presentation supports the given Exemplar. As you learn how to generate the appropriate type of presentation you will be learning how to do the inverse problem, e.g., recognition of an Exemplar from a presentation of work. It is the inverse problem that was discussed in the previous section and is what you will need to learn how to do if you are to master self evaluation.

At some point in the class, after the instructor feels that you have indeed mastered the presentation of work for some Exemplar, the instructor may ask you to demonstrate that you truly understand the Exemplar, by having you explain why some set of work in your Portfolio shows mastery of the competency categories at the Exemplar of interest (e.g., *persuade me that you understand what is needed to be at the Analysis level of learning*). The way you will do this is to create a Reflection Log for the work in question.

As discussed earlier, a Reflection Log discusses the process you went through in deciding which Exemplar most closely matches the presented work. A Reflection Log is **not** a discussion of the work that is done as an expected part of the presentation of the work (see Part II). Rather, a Reflection Log focuses on the general characteristics or traits of the work, characteristics or traits that allow you to match the work with an Exemplar. For example, if you were writing a log for the previous bridge design report work and were making a case that the presented work supported a claim of Synthesis level of learning you would need to look for:

1. the existence of well presented technical work
   (see Typical Work Products and Process Verbs for Synthesis)
2. the existence of a report or work that tied all the technical work together
   (see Typical Work Products for Synthesis)
3. discussion that was related to the creation of something
   (see Typical Questions and Process Verbs for Synthesis).

In the Reflection Log you would want to point out where in the presented work you could find examples of these three things. Thus, for example, you could point out the existence of the report as one of the work products supporting your claim of Synthesis. You would need to point out sections of the report where the discussion focused on creation (addresses issue 3). You would probably also want to point out the absence of work products associated with Evaluation.

How Many Reflection Logs

For this class you will only be writing Reflection Logs when the instructor so requests and this will usually happen after you have demonstrated in your Portfolio, as evaluated by the instructor and your peers, that you can consistently prepare and present work at some level of learning. In other words, you will be asked to write these Refection Logs only after you have demonstrated a Comprehension Level of Learning concerning the Exemplar of interest. You will write at least one log for each level of learning (Exemplar). If the first log fails to show an adequate grasp of the issues associated with the Exemplar, (i.e., fails to show you are at Comprehension Level of Learning for the Exemplar) you will write another log, for a different body of work in your Portfolio.

Filling In The Competency Matrix Gray Boxes (step 6)

This is the last, and by far the easiest, step in the entire process. The filling in of the gray boxes should occur at a relatively uniform rate during the semester. Entries in these gray boxes depends on whether they are affective or cognitive boxes.

Cognitive Gray Boxes

After you have determined the appropriate Exemplar (LoL for the work), you simply enter the portfolio (Design Notebook) page numbers that contain the evidence supporting your claim. This would be the first page of the work product or report. It could also be the page number for a figure or chart within a body of work.

Affective Gray Boxes

Collecting demonstration material for the gray affective boxes is a bit more difficult, especially for Valuing where the Exemplar uses terms like *believe* and *feel*, things not easy to capture in your presentation of work. This is the first year in which the affective domain has been explicitly used in the Competency Matrix and I hope the class and I will learn together about how to document these affective boxes. However, until another methods as been determined the gray affective boxes are to be handled as follows.

1. Receiving
   It seems very unlikely that you can operate at the cognitive Knowledge level without operating at the Receiving degree. Thus, by inference, you can claim proof of Receiving any time you justify Knowledge. Put the same Portfolio page number entry in the Receiving gray box as you put in the Knowledge gray box.

2. Responding
   It again seems very unlikely that you can operate at the cognitive Comprehension level without operating at the Responding degree. Thus, by inference, you can claim proof of Responding any time you justify Comprehension . Put the same Portfolio page number entry in the Receiving gray box as you put in the Knowledge gray box.
3. Valuing
   These boxes are a bit more difficult. Presentations of technical work, even high quality presentations, do not contain the sort of information that would allow a person to deduce whether or not you valued the process or methods being used. If you feel you have reached this degree of internalization then you will need to prepare a Reflection Log that explains why you have reached this degree. This Valuing Reflection Log will contain information not found in the presentation of the work, but germane to establishing your claim of Valuing.

   It may be that you do not feel that you have reached the Valuing degree by the end of the semester. If this happens, prepare a Reflection Log that discusses why you have not reached Valuing and refer to that log in the Competency Matrix.

   For these Valuing Reflection Logs, you should enter the Reflection Log Page number into the gray box (you can also enter the Reflection Log item number in the gray box if there is room)

   Run Chart Competency Categories

You **may** find some of the competency categories in your Competency Matrix have been marked as *run chart* categories. This designation is given to those categories that cannot be documented with a single effort but require a semester long accumulation of efforts to show achievement of the category. For such categories you will be maintaining a run chart that shows your semester long commitment and, at the end of the semester, you will place that run chart's page number in the competency matrix box.

When Can You Claim Level or Degree Mastery?

If for some competency category you show you can operate at an educational state **once**, does that mean that in this class you would **always** operate at that state? That is, if you were to work a **second** problem using the same competency category would the second effort always be at the same educational state as the first effort? If the answer is maybe or maybe not, then how many times must you perform at some educational state before you can safely claim **retention** of the level (i.e., claim *mastery* [16]of the educational state).

This discussion of *mastery* is limited to the time period you are in this class and does **not** include what happens to your educational states once you leave the class. There is no question that, if you **do not** subsequently use the competency category items in future classes or work related activities, the educational states you achieve in this class will decay. The curriculum, of which this class is a part, has been developed with an awareness of this time decaying nature of educational states and has been constructed to give you many opportunities, in a series of classes, to use the competency categories that need to have continual growth (or at least no decay) to support educational states. The expected educational states shown in the Competency Matrix for this class are consistent with either the educational states needed in further classes or the desired, BS graduate, life long levels of performance.

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[16] Note this material is using mastery of a competency category at a level or degree and **not** mastery of the category, which generally implies being able to work, unconsciously at the highest cognitive level, i.e., being an expert of the category. *Mastery* , as used in this section, also does **not** have any performance speed attached to the meaning. *Mastery* does **not** mean that you have instant recall or the ability to instantly solve the problem at the educational state claimed.

APPENDIX A

Activities at Various Cognitive Levels of Learning and Affective Degrees of Internalization

Activities at Various Levels of Learning

KNOWLEDGE (INFORMATION)

How do I know I have reached this level?

I recall information. I bring to mind the appropriate material at the appropriate time. I have been exposed to the information and can respond to questions, tasks, etc.

What do I do at this level?

I read material, listen to lectures, watch videos, take notes and I am able to pass a test of knowledge on the subject area. I learn the vocabulary of the competency area, i.e., the terminology. I learn the conventions used.

How will the teacher know I am at this level?

The teacher will provide opportunities (either orally or in written tests), regardless of complexity, that can be answered through simple recall of previously learned material.

What does the teacher do at this level?

The teacher directs, tells, shows, identifies, examines the information necessary at this level.

What are typical ways I can demonstrate my knowledge?

1. Define technical terms by giving their attributes, properties, or relations.
2. Recall the major facts about a particular subject
3. List the characteristic ways of treating and presenting ideas (i.e., list conventions associated with the subject)
4. Name the classes, sets, divisions, and arrangements that are regarded as fundamental for a given subject field or problem.
5. List the criteria used to judge facts, principles, ideas.
6. Describe the method(s) of inquiry or techniques and procedures used in a particular field of study.
7. List the relevant principles and generalizations
8. Fill in the blank

What are typical work products?

1. hand written answers to Knowledge quizzes (True/False, Yes/No, multiple choice, fill in the blank)
2. lists of definitions

What are descriptive Process verbs?

define label listen list
memorize name read recall
record relate repeat view

Modifications by B. McNeill of David L. Langford's definitions of Levels of Learning in, *Total Quality Learning Handbook*, Langford Quality Education and B. Bloom et. al's *Taxonomy of Educational Objectives*, Longmans, Green and Co., 1956.

Activities at Various Levels of Learning

COMPREHENSION (UNDERSTANDING)

How do I know I have reached this level?

I comprehend and understand what is being communicated and make use of the ideas but without relating them to other ideas or material. I may not yet understand the fullest meaning. I understand what others are discussing concerning this idea. This level requires Knowledge.

What do I do at this level?

I successfully work assignments in which the appropriate approach is evident either because of material in the problem statement or because of the problem's relative location in the book to the appropriate method. I translate information into my own words (translation from one level of abstraction to another). I translate symbolic information (e.g., tables, diagrams, graphs, mathematical formulas, etc.) into verbal forms, and vice versa. I interpret or summarize communications (written/graphical/oral). I determine implications, consequences, corollaries, effects, etc. that are extensions of trends or tendencies beyond the given data.

How will the teacher know I am at this level?

The teacher will often ask questions or give tests that can be answered by merely restating or reorganizing material in a rather literal (clearly stating the facts or primary meaning of the material) manner to show that I understand the essential meaning, e.g., give the ideas in your own words.

What does the teacher do at this level?

The teacher demonstrates, works problems, listens, questions, compares, contrasts, and examines the information and your knowledge of it.

What are typical ways I can demonstrate or can show on my own my comprehension and understanding.

1. Read (Comprehension type) problems, know what is being asked for, and successfully work the problems
2. Clearly chronicle the process used in working the problem
3. Clearly describe the results of working a problem
4. Draw conclusions (interpret trends) from the results of solving a problem
5. Compare/contrast two different problems (i.e., what things are the same?/what things are different?)
6. Restate an idea, theory, principle in your own words.

What are typical work products?

1. hand written answers to Comprehension quizzes and exams (problems, multiple choice)
2. work associated with homework problems, presented with enough information that it is clear what the problem is, why it is being worked, what general method is being used, and what the results of the work mean

What are descriptive process verbs?

describe explain express identify locate recognize report
restate review tell work

Modifications by B. McNeill of David L. Langford's definitions of Levels of Learning in, *Total Quality Learning Handbook*, Langford Quality Education and B. Bloom et. al's *Taxonomy of Educational Objectives*, Longmans, Green and Co., 1956.

Activities at Various Levels of Learning

APPLICATION (THINKING)

How do I know I have reached this level?

I have the ability to recognize the need to use an idea, method, concept, principle, or theory without being told to use it, i.e., I have the ability to use ideas, methods, concepts, principles and theories in new situations. I know and comprehend the information and can apply it to a new situation. I also have the ability to recognize when a certain task, project, theory or concept is beyond my current competency. Application requires having Knowledge and Comprehension.

What do I do at this level?

I work problems in which the solution method is not immediately evident or obvious. I take knowledge that has been learned at the Knowledge and Comprehension Level of Learning and apply it to new situations. I solve problems on my own and make use of other techniques. This requires not only knowing and comprehending information, but deep thinking about the usefulness of this information and how it can be used to solve new problems that I create or identify.

How will the teacher know I am at this level?

I will show the teacher through my work that I am involved in problem solving in new situations with minimal identification or prompting of the appropriate rules, principles, or concepts by the teacher. The teacher will be able to ask general questions like, *How much protection from the sun is enough* and I will know how to attack the problem.

What are the typical ways I can demonstrate or show, on my own, my application of knowledge and understanding?

1. Solve problems that require recognition of the appropriate concepts, theories, solution techniques, etc.
2. Apply the laws of mathematics (chemistry, physics, engineering) to practical situations
3. Work *project type* problems

What are typical work products?

1. work that looks very much like that produced for Comprehension plus some additional information that shows you recognized the need to use the solution methods utilized

What are descriptive process verbs?

apply
interpret
demonstrate
operate
employ
practice
illustrate
recognize

Modifications by B. McNeill of David L. Langford's definitions of Levels of Learning in, *Total Quality Learning Handbook*, Langford Quality Education and B. Bloom et. al's *Taxonomy of Educational Objectives*, Longmans, Green and Co., 1956.

Activities at Various Levels of Learning

ANALYSIS (THINKING)

How do I know I have reached this level?

I can explain *why*. I can examine, methodically, ideas, concepts, writing etc. and separate into parts or basic principles. I have the ability to break down information into component parts in order to make organization of the whole clear. Work at this level requires having Knowledge and Comprehension Levels of Learning (Application is not required).

What do I do at this level?

I analyze results by breaking concepts, ideas, theories, etc. apart. I can explain the logical interconnections of the parts and can develop detailed cause and effect chains.

What does the teacher do at this level?

The teacher probes, guides, observes, and acts as a resource.

What are typical questions I can pose for myself to answer that will demonstrate or show my Analysis Level of Learning?

1. Why did this (result) happen?
2. What reason does she give for her conclusions?
3. Does the evidence given support the hypothesis, the conclusion?
4. Are the conclusions supported by facts, opinions, or analysis of the results?
5. What are the causal relationships between the results for the whole and the parts?
6. What are the unstated assumptions?

What are typical work products?

1. hand written or word processed answers to Analysis exams (problems, multiple choice, essays)
2. work that looks very much like that produced for Comprehension but it has some additional discussion of the work. The type, amount, and depth of discussion (see items above) is what distinguishes the work from Comprehension

What are descriptive process verbs?

break apart break down examine explain

Modifications by B. McNeill of David L. Langford's definitions of Levels of Learning in, *Total Quality Learning Handbook*, Langford Quality Education and B. Bloom et. al's *Taxonomy of Educational Objectives*, Longmans, Green and Co., 1956.

Activities at Various Levels of Learning

SYNTHESIS (THINKING)

How do I know I have reached this level?

I have the ability to put together parts and elements into a unified organization or whole that requires original, creative thinking. I recognize new problems and develop new tools to solve them. I create my own plans, models, hypotheses for finding solutions to problems. This Level of Learning requires Knowledge, Comprehension, Application and Analysis Levels of Learning.

What do I do at this level?

I put ideas together to create something. This could be a physical object, a process, a design method, a communication, or even a set of abstract relations (i.e., mathematical models). I produce reports (written/oral) that create a desired effect (e.g., information acquisition, acceptance of a point of view, continued support, etc.) in the reader (listener). I generate project plans. I propose designs. I formulate hypotheses based on the analysis of pertinent factors. I am able to generalize from a set of axioms, principles.

How will the teacher know I am at this level?

I show that I can combine ideas into a statement, plan, product, etc., that is new for me; e.g., can I develop a program that includes the best parts of each of those ideas?

What does the teacher do as this level?

The teacher reflects, extends, analyses, and evaluates.

What are the typical questions I can answer that will demonstrate or show my synthesis?

1. Can I create a project plan?
2. Can I develop a model?
3. Can I propose a design?

What are typical work products?

1. hand written or word processed answers to Synthesis exams (problems, multiple choice, essays)
2. work that looks very much like that produced for Comprehension but it has some additional discussion of the work. The type, amount, and depth of discussion (see items above) is what distinguishes the work from Comprehension

What are descriptive process verbs?

arrange
assemble
collect
compose
construct
create
design
formulate
manage
organize
plan
prepare
propose
set up
write

Modifications by B. McNeill of David L. Langford's definitions of Levels of Learning in, *Total Quality Learning Handbook*, Langford Quality Education and B. Bloom et. al's *Taxonomy of Educational Objectives*, Longmans, Green and Co., 1956.

Activities at Various Levels of Learning

APPRECIATION/EVALUATION (WISDOM)

How do I know I have reached this level?

I have the ability to judge and appreciate the value of ideas, procedures and methods using appropriate **criteria**. To work at this level requires having achieved Knowledge, Comprehension, Application, Analysis and Synthesis Levels of Learning.

What do I do at this level?

I make value judgments based on certain considerations such as usefulness, effectiveness, and so on. Based on information gained through application, analysis, and synthesis I can rationally select a process, a method, a model, a design, etc. from among a set of possible processes, methods, models, design, etc. I evaluate competing plans of action before actually starting the planed work. I evaluate work based on internal standards of consistency, logical accuracy, and the absence of internal flaws (e.g., I can certify if design feasibility has been demonstrated in a report). I evaluate work based on external standards of efficiency, cost, utility to meet particular ends (e.g., I can. certify that design quality has been demonstrated in a report).

How will the teacher know I am at this level?

I can demonstrate that I can make a judgment about something using some criteria or standard for making the judgment.

What does the teacher do at this level?

The teacher clarifies, accepts, harmonizes, aligns and guides.

What are typical statements and questions I can respond to that will demonstrate or show my appreciation/evaluation?

1. I can evaluate an idea in terms of ...
2. For what reasons do I favor...
3. Which policy do I think would result in the greatest good for the greatest number?
4. Which of these models (i.e., modeling approaches) is best for my current needs?
5. How does this report show that the design is feasible?
6. How does this report show the quality of the design?

What are typical work products?

1. hand written or word processed answers to Evaluation exams (problems, multiple choice, essays)
2. work that looks very much like that produced for Comprehension but it has some additional discussion of the work. The type, amount, and depth of discussion (see items above) is what distinguishes the work from Comprehension

What are descriptive process verbs?

appraise
choose
compare
estimate (quality)
evaluate
judge
predict (quality)
rate value
select

Modifications by B. McNeill of David L. Langford's definitions of Levels of Learning in, *Total Quality Learning Handbook*, Langford Quality Education and B. Bloom et. al's *Taxonomy of Educational Objectives*, Longmans, Green and Co., 1956.

Affective Domain

RECEIVING (ATTENDING)

The degree of Receiving ranges from simple awareness, to a willingness to receive, and finally to controlled or selected attention. You must first become aware of information, concepts, theories, etc. before you can decide whether or not you are willing (and able!) to receive this information, etc. The next decision is naturally whether or not this information, etc. is important enough to merit your controlled or selected attention.

What do I do at this degree?

At this degree of internalization I am concerned only with my conscious recognition of the existence of certain phenomena and stimuli (i.e., I am willing to receive or attend to these phenomena and stimuli). I am willing to listen to lectures, read books, or watch videos and am aware[17] of the material being presented in the lectures, books, videos[18]. I have written notes or sketches related to the presentation.

How do I know I have reached this degree?

At the end of a lecture, book or video, I can select from a set of topics the ones that were presented in the material. I can list or briefly summarize points from the presentation.

What are descriptive process verbs?

concentrate
pay attention
remember
feel (touch)
read
smell
listen
recognize
watch

---

[17] Does not imply Comprehension or Knowledge of the material only awareness

[18] A point of caution: being willing to receive may not actually ensure that you are receiving. You do not come to class *de novo*. Because of previous experiences (formal or informal), you bring a point of view which may facilitate or hinder recognition of the teacher presented phenomena. These *a priori* points of view (also referred to as paradigms or learning styles) can filter your attending causing you to actually not receive the intended material, even when you are willing to receive the material.

Modifications and paraphrasing by B. McNeill and L. Bellamy of David Krathwohl et. al's *Taxonomy of Educational Objectives Book 2 Affective Domain*, Longman, 1964

Affective Domain

RESPONDING

The degree of Responding ranges from simply agreeing to respond, to a willingness to respond, and finally to actually getting some satisfaction from responding to directions, requests, information, concepts, theories, etc.

What do I do at this degree?

I learn by doing[19]. I answer questions in class when called upon. I do the work assigned by the instructor for this class. I attend and participate in team meetings organized by the instructor. Outside of class, I spontaneously discuss course material with classmates and especially with friends who are not classmates. I ask questions in class. I prepare notes on my reading assignments. I reorganize and integrate my class notes with my reading assignment notes. I participate in the learning activities created by the instructor, both those inside the classroom and those outside of the classroom. I make an effort to find the class material interesting and useful. I may use it as the basis of written or oral reports in other classes [20].

How do I know I have reached this degree?

I feel comfortable with my team (i.e., I know that I am contributing at least what is expected by my teammates). I meet the class deadlines. I invest the expected level of effort for the class. I attend class regularly and arrive on time. I have work products or deliverables, that I have constructed for this class, that are well organized and accessible.

What are descriptive process verbs?

calculate
discuss
draw
integrate
make
organize
play
sketch
talk
write

---

[19] As paradigms can color what you actually receive, fear can keep you from responding, even when you are willing. Fear of failure (as judged by an instructor or peer), fear of looking silly, fear of ridicule, fear of missing the point, fear of punishment, fear of a poor grade, fear is a powerful, extrinsic DEmotivater which you will have to address before you reach the Responding degree of internalization.

[20] Responding is still a rather low level of commitment and it would be incorrect to say that you *value* the material or that you actively displayed an *attitude* toward the material.

Modifications and paraphrasing by B. McNeill and L. Bellamy of David Krathwohl et. al's *Taxonomy of Educational Objectives Book 2 Affective Domain*, Longman, 1964

Affective Domain

VALUING

The degree of Valuing ranges from simply accepting the values presented by the instructor, to preferring these values, and finally to actually making a commitment to these values. The values of interest here are the directions, requests, information, concepts, theories, etc. specified in the written course material or orally by the instructor during the course.

What do I do at this degree?

I frequently use the material (i.e., skills, methods, knowledge, etc.) that I have learned to solve problems. I may try to teach the material to people who are not familiar with the material or people who are having difficulty understanding the material. I use the material in activities unrelated to this class. I form or take part in study groups to further understand the material. I may challenge people who are skeptical about the material in an effort to help them eliminate or at least reduce their skepticism.

How do I know I have reached this level?

I believe the material I have learned is useful and helps me solve problems. Also, I can justify or explain this belief both to my self and to others. I make a concerted effort to obtain more information about the class material (e.g., obtain additional books, watch extra videos, attend other classes or seminars). I am concerned when people express their skepticism or doubts about the material and its value or usefulness. I am comfortable working in teams or working alone. I am interested in the class material and demonstrate curiosity, honesty, integrity and truthfulness in dealing with others and in the work products or deliverables I produce for the class.

What are descriptive process verbs?

care convince use

Modifications and paraphrasing by B. McNeill and L. Bellamy of David Krathwohl et. al's *Taxonomy of Educational Objectives Book 2 Affective Domain*, Longman, 1964

APPENDIX B

Competency Matrix
Reflection Log Template
Work Log Template
Sample Run Chart

Sample Competency Matrix

Before Class ● After Class ▨

Learning Outcomes	Competency Categories	comp #	Affective Degree			Cognitive Level					
			Receiv-ing	Respond-ing	Value-ing	Knowl-edge	Compre-hension	Appli-cation	Analy-sis	Syn-thesis	Evalua-tion
1. differentiation	exponential functions	1.1	▨	▨		▨	▨				
	hyperbolic functions	1.2	▨	▨		▨	▨				
	implicit	1.3	▨	▨		▨	▨				
	polynomials	1.4	●	▨		▨	▨				
	trigonometric functions	1.5	▨	▨		▨	▨				
2. team meetings	code of cooperation	2.1	▨	▨		▨	▨				
	constructive feedback	2.2	▨			▨					
	devils advocate	2.3	▨	▨		▨	▨				
	gatekeeper	2.4	▨	▨		▨	▨				
	norms	2.5	▨			▨					
	team facilitator	2.6	▨	▨		▨	▨				
	team leader	2.7	▨	▨		▨	▨				
	team member	2.8	▨	▨		▨	▨				
	time keeper	2.9	●	▨		●	▨				

Reflection Log Template

Log Entry Number:

Competency Category(s):

Level of Learning and/or Degree of Internalization Claimed:

Location of Supporting Work

Reflection

Log Entry Number:

Competency Category(s):

Level of Learning and/or Degree of Internalization Claimed:

Location of Supporting Work

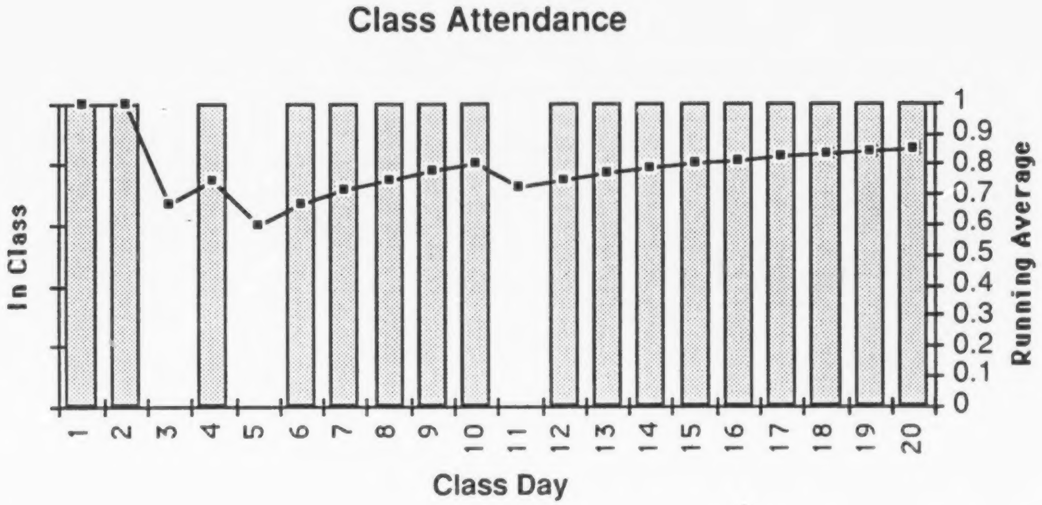
Reflection

Work Log Template

Log Entry Number	Name of Person Doing the Work	Date	Total Time Spent (decimal hours)	Location of Work in Portfolio	Work Code

Work Code	Definition	Work Code	Definition
1.		5.	
2.		6.	
3.		7.	
4.		8.	

Example Run Chart



SECTION D
Introduction to Teams

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The Environment and Purpose

D-1

- Learning Environment
  - Active (as opposed to Passive)
  - Group or team based
  - Workshop facilitators (not Lecturers)
- Purpose and Expected Participant Outcomes
  - Learn the Principles of Team Dynamics
  - Apply the Principles to Create Effective Teams
  - Plan, Lead, and Participate in Effective Meetings

Getting Started

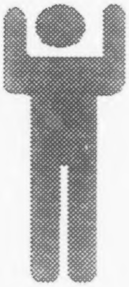
D-2

- Forming Groups
- 'Focus on the Facilitator' Signal
- Issue Bin
- Code of Cooperation
- Self Evaluation Matrix

Forming Groups

- *Groups of 5 or more are appropriate for this workshop.*
- *Take a seat an any table or arrange the chairs in the room to accommodate 5 or more people.*
- *Make an effort to seat yourself with people you do not know*

'Focus on Facilitator' Signal



The facilitator needs your attention:

- *Raise your hands to inform your neighbors*
- *Finish your sentence*
- *Do NOT finish your paragraph*
- *Turn toward the Facilitator*

☑ Issue Bin (a useful tool !)

D-5

- ❖ Someone will be assigned to be the Issue Bin Collector
- ❖ The following issues will be assigned to the Issue Bin:
  - topics that will or may be addressed later
  - questions that can or should be deferred until the end of the workshop
  - items that can or should be the subject of future workshops
- ❖ Paraphrase the issue and record on the board or a piece of paper which is always visible
- ❖ At the conclusion of the session or workshop, the issues in the issue bin are brought out, one at a time, and discussed to see if they are still issues.
- ❖ Any issues which remain after the discussion must be addressed in a future workshop.

☑ Code Of Cooperation

D-6

1. EVERY member is responsible for the team's progress and success.
2. Attend all team meetings and be on time.
3. Come prepared.
4. Carry out assignments on schedule.
5. Listen to and show respect for the contributions of other members; be an active listener.
6. CONSTRUCTIVELY criticize ideas, not persons.
7. Resolve conflicts constructively.
8. Pay attention, avoid disruptive behavior.
9. Avoid disruptive side conversations.
10. Only one person speaks at a time.
11. Everyone participates, no one dominates.
12. Be succinct, avoid long anecdotes and examples.
13. No rank in the room.
14. Respect those not present.
15. Ask questions when you do not understand.
16. Attend to your personal comfort needs at any time but minimize team disruption.
17. HAVE FUN !!!
18. ?

adapted from the Boeing Airplane Group team Member Training Manual

Competency Matrix

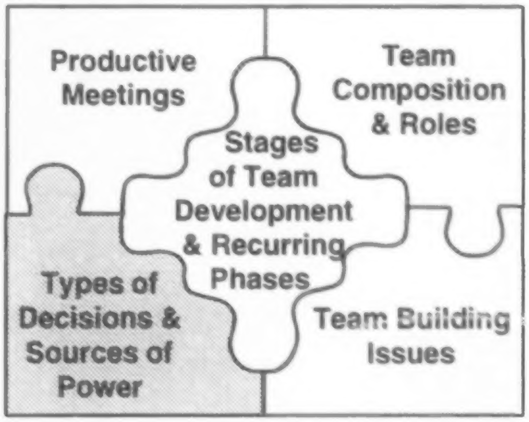
- ❖ A 'snap shot' of a person's level of learning or degree of internalization for a variety of concepts or skills
- ❖ An L matrix of concepts, topics or skills to be learned

versus

levels (or stages) of learning and
degrees of internalization

- ❖ The matrix is filled out by person being evaluated
- ❖ It must be constructed by the person responsible for
  (1) establishing the course objectives, and
  (2) designing both the learning experiences and assessment instruments required to achieve the course objectives.

Making Teams Out of Groups


Productive Meetings
Team Composition & Roles
Stages of Team Development & Recurring Phases
Types of Decisions & Sources of Power
Team Building Issues

Making Teams Out of Groups : Session Structure

- ❖ Lecturette on Why Teams are Important (10 minutes)
- ❖ Jigsaw on Team Dynamics (125 minutes)

  (presented in two class sessions with breaks !)
- ❖ Session Process Check (5 minutes)
- ❖ Jigsaw Process Check (15 minutes)

What is a team anyway?

A team is a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually acountable[1].

- ❖ Small Number
- ❖ Complementary Skills
- ❖ Common Purpose & Performance Goals
- ❖ Common Approach
- ❖ Mutual Accountability

[1] Jon R. Katzenbach & Douglas K. Smith. 1993. *The wisdom of teams: Creating the high-performance organization.* Cambridge, MA: Harvard Business School Press.

Use of Teams

In industry / business:

- Management teams (Team Xerox, San Diego Zoo)
- Continuous Quality Improvement teams (CQI)
- Design/Build teams (Chrysler H-car, Boeing 777)

> "The task for us at Boeing is to provide a massive change in thinking throughout the company - this is a cultural shift, and it isn't easy!"
> Phil Condit,
> Executive Vice President
> Boeing Commercial Airplanes

In academe:

- Cooperative learning
  - Short-term groups
  - Long-term groups
  - Base groups
- Project-based courses
  - Single-discipline teams
  - Multi-disciplinary teams
- Design Courses
  - Technical multi-disciplinary teams
  - Cross-functional teams (marketing, engineering, law, etc.)

Rating of Employee's Overall Employment Potential

100 Has demonstrated superior technical competence in a wide range of skills, *has displayed outstanding leadership and team skills at every opportunity*; learns & adapts to changing circumstances quickly; achieves more than expected through consistently hard work & dedication, finds innovative solutions to problems; demonstrates a passion for exceeding the expectations of customers; communicates exceptionally well spontaneously with little or no preparation

Overall Rating (1 to 100) ☐

90

80

70

Factors to be considered in making overall rating

Attitude
Ability to Learn
Results
Work Ethic
Technical Competence
Innovation
Leadership
Teamwork
Communication
Customer Orientation

60 Has consistently applied acceptable technical competence within several skill areas; *has occasionally demonstrated strong leadership and team skills when conditions were favorable*; adapts to changing circumstances and learns new skills when necessary; gets acceptable results and puts in "a good day's work for a good day's pay;" occasionally develops innovative solutions to problems; shows a modest interest in meeting the needs of customers; communicates well with certain groups and on familiar topics

50

40

30

20

10 Has marginal technical competence with certain skill areas; *displays little interest in assuming leadership; tends to cause dissension among team members; works best in isolation*; resists change; shows pattern of absence from work suggestive of lack of dependability; when faced with problems, seeks out others to solve them; demonstrates little concern for anticipating the needs of customers; awkward in communicating ideas to others

0

Actual rating form used by employer of engineers

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INTERVIEW RATING SHEET

D - 13

POSITION: ____________________ APPLICANT: ____________________
DATE: ____________________

The Performance Skills to be evaluated	Evidence skill NOT present	Evidence Some skill present	Evidence Adequate Skill Present	Evidence Above Average skill present	Evidence Superior skill present	Insufficient evidence for or against skill
(1) RISK-TAKING/INNOVATION	①	②	③	④	⑤	
(2) TEAM SKILLS	①	②	③	④	⑤	
(3) LEADERSHIP	①	②	③	④	⑤	
(4) PROBLEM-SOLVING SKILL	①	②	③	④	⑤	

NOTES:

Actual rating form used by employer of engineers

What Employers Want: A Summary

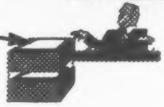
D - 14

- ❖ Learning to Learn
- ❖ Listening and Oral Communication
- ❖ Competence in Reading, Writing, and Computation
- ❖ Adaptability: Creative Thinking and Problem Solving
- ❖ Personal Management: Self-Esteem, Goal Setting/Motivation and Personal/Career Development
- ❖ Group Effectiveness: Interpersonal Skills, Negotiation, and Teamwork
- ❖ Organizational Effectiveness and Leadership

Source: *Workplace Basics: The Skills Employers Want*, American Society for Training and Development and U.S. Department of Labor, Employment and Training Administration, 1988.

D - 15

Classification of Tasks :



1. Can the task be **SUBDIVIDED**?

   Is it **Divisible,**
   or **Unitary** (Indivisible)?

2. What is the **GOAL** of the task?

   Is it to **Optimize quality,**
   or **Maximize quantity**?

3. How are individual **EFFORTS** related to the team's performance?

   Is it **Conjunctive** - All team members must contribute to the task

   Disjunctive - If one gets it, then all get it (eureka/non-eureka)

   Additive - Rope tug, stuffing envelopes

   Compensatory - One person's extra effort makes up for another's reduced effort

   Discretionary - Team decides how individual efforts relate to team performance

D - 16

Why Use Teams ?

Teams are vital because all the following are divisible, optimizing, conjunctive tasks:

- ❖ Effective meetings
- ❖ Strategic planning
- ❖ Implementing innovation
- ❖ Designing continuous improvement projects

Meetings

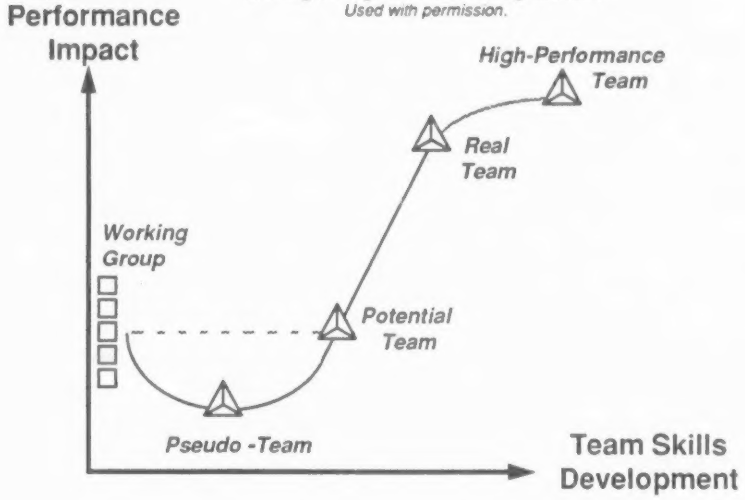
Most Teamwork Occurs through
Face-to-Face Interaction in Meetings

- ❖ Over 19 million meetings take place everyday in the U.S.
- ❖ People spend over 1/2 their working life conducting, attending, preparing for and following up on meetings
- ❖ Almost 1/2 of all meetings are considered unnecessary by the people who attend

Good teamwork requires effective meetings!

Impact of Team Development

*From: Katzenbach & Smith, **The Wisdom of Teams: Creating the High-Performance Organization**.*
Used with permission.



SECTION E
Team Dynamics Jigsaw

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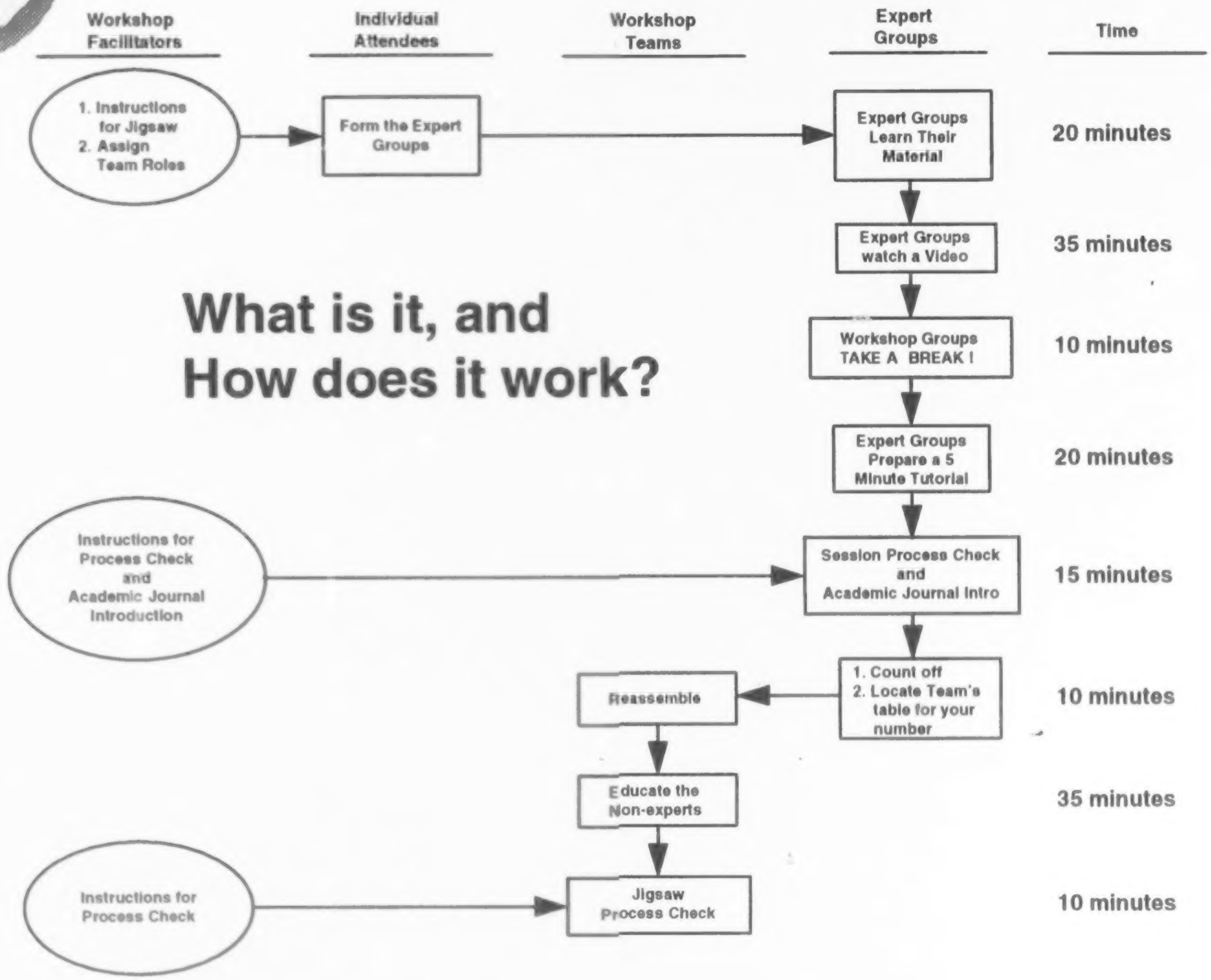
Jigsaw on Team Dynamics

What is it, and How does it work?



Workshop Facilitators

Individual Attendees

Workshop Teams

Expert Groups

Time

1. Instructions for Jigsaw
2. Assign Team Roles

Form the Expert Groups

Expert Groups Learn Their Material

20 minutes

Expert Groups watch a Video

35 minutes

Workshop Groups TAKE A BREAK !

10 minutes

Expert Groups Prepare a 5 Minute Tutorial

20 minutes

Instructions for Process Check and Academic Journal Introduction

Session Process Check and Academic Journal Intro

15 minutes

1. Count off
2. Locate Team's table for your number

Reassemble

10 minutes

Educate the Non-experts

35 minutes

Instructions for Process Check

Jigsaw Process Check

10 minutes

Topic for Expert Table 1

Guidelines for Productive Meetings

Although individual team members carry out assignments between team meetings, much of the team's work gets done when all team members are together--during meetings. Many people dislike meetings, but meetings don't have to be disliked. Like other processes, they can be studied and constantly improved. Productive meetings enhance the chance of having a successful project.

It is difficult to have productive meetings because few people know the rules and skills needed. In fact, the goal of having constantly improved meetings may be as hard for the team to reach as the improvement goals set for the project. The best way to have productive meetings is to follow the guidelines given below from the start of the project, a time when the members expect to learn new ways of working together.

1. **Use agendas**

Each meeting must have an agenda, preferably one drafted at the previous meeting and developed in detail by one or two members prior to the actual meeting. It should be sent to participants in advance, if possible. (If an agenda has not been developed before a meeting, spend the first five or ten minutes writing one on a flipchart.)

Topic for Expert Table 1

Productive Meetings Continued

Agendas should include the following information:

- The agenda topics (including, perhaps, a sentence or two that defines each item and why it is being discussed).
- The agenda should define the process to be used in coming to a decision (e.g., brainstorming, affinity process, multi-voting, etc.) and not simply state "discuss. . ."
- The agenda should order the topics in a logical order so that items that need to be decided first are taken up first.
- The presenters (usually the person who originated the item or the person most responsible or knowledgeable about it).
- A time guideline (the estimated time in minutes needed to discuss each item).
- The item type--whether the item requires discussion or decision, or is just an announcement.

Agendas usually list the following activities:

- Warm-ups: short (five to ten minute) activities used to free people's minds from the outside world and get them focused on the meeting.
- A quick review of the agenda. Simply start each meeting by going over the agenda, adding or deleting items, and modifying time estimates.
- Breaks for long meetings. If the meeting lasts more than two hours, schedule at least one short break.
- Meeting evaluation. This is perhaps the most important item on the agenda.

Topic for Expert Table 1

Productive Meetings Continued

Although some of these elements may be unfamiliar, we encourage team leaders to introduce them at the first meeting and include them in all subsequent meetings. Team members will probably feel awkward at the first meeting anyway, and a new activity will not add much to that awkwardness. As members become more comfortable with the group, they will feel less self-conscious about these activities.

2. **Have a facilitator**
   Each meeting should have a facilitator who is responsible for keeping the meeting focused and moving. Ordinarily, this role is appropriate for the team facilitator, but your team may rotate the responsibility among its members. Among the facilitator's chief responsibilities are:
   - Encourage compliance with the Code of Cooperation and other team norms;
   - Keep the discussion focused on the topic and moving along;
   - Intervene if the discussion fragments into multiple conversations;
   - Tactfully prevent anyone from dominating or being overlooked;
   - Bring discussions to a close.

The facilitator should also notify the group when the time allotted for an agenda item has expired or is about to expire. The team then decides whether to continue discussion at the expense of other agenda items or postpone further discussion until another meeting.

Productive Meetings Continued

3. Take minutes
Each meeting should also have a scribe who records key subjects and main points raised, decisions made (including who has agreed to do what and by when), and items that the team has agreed to raise again later in this meeting or at a future meeting. Team members can refer to the minutes to reconstruct discussions, remind themselves of decisions made or actions that need to be taken, or to see what happened at a meeting they missed. **Rotate this duty among the team members.**

4. Draft next agenda
At the end of the meeting, draft an agenda for the next meeting.

5. Evaluate the meeting
Always review and evaluate each meeting, even if other agenda items go overtime. The evaluation should include decisions on what will be done to improve the meeting next time and helpful feedback to the team leader. You may want to experiment with mid-meeting evaluations

6. Adhere to the "100-mile rule"
Once a meeting begins, everyone is expected to give it their full attention. No one should be called from the meeting unless it is so important that the disruption would occur even if the meeting was 100 miles away from the workplace. The "100-mile rule" will need to be communicated--perhaps repeatedly--to those who keep taking phone messages or would interrupt the team's work for other reasons.

Topic for Expert Table 1

Productive Meetings Continued

Effective Meeting Structure

Detailed AGENDA

- Issued in advance of meeting
- Preassigned meeting roles
- Agenda topics
  - A sentence or two defining the item including a clearly articulated objective
  - In logical order of action
- Presenters, Resources Required, Assignments, etc.
- Time guideline

Use of quality tools

- Appropriate tool for the task at hand
- Team trained in use of tool

Post-meeting evaluation

Topic for Expert Table 1

Productive Meetings Continued

Meeting Evaluation

Effectiveness

- Are we doing the right things?
- Are we asking the right questions?
- Are we tackling the right problems?

Efficiency

- Are we taking unnecessary steps?
- Are we reinventing the wheel?
- Are we spinning our wheels?
- Are we looking for process related problems?
- Are we using appropriate quality tools?
- Are we straying from the agenda?

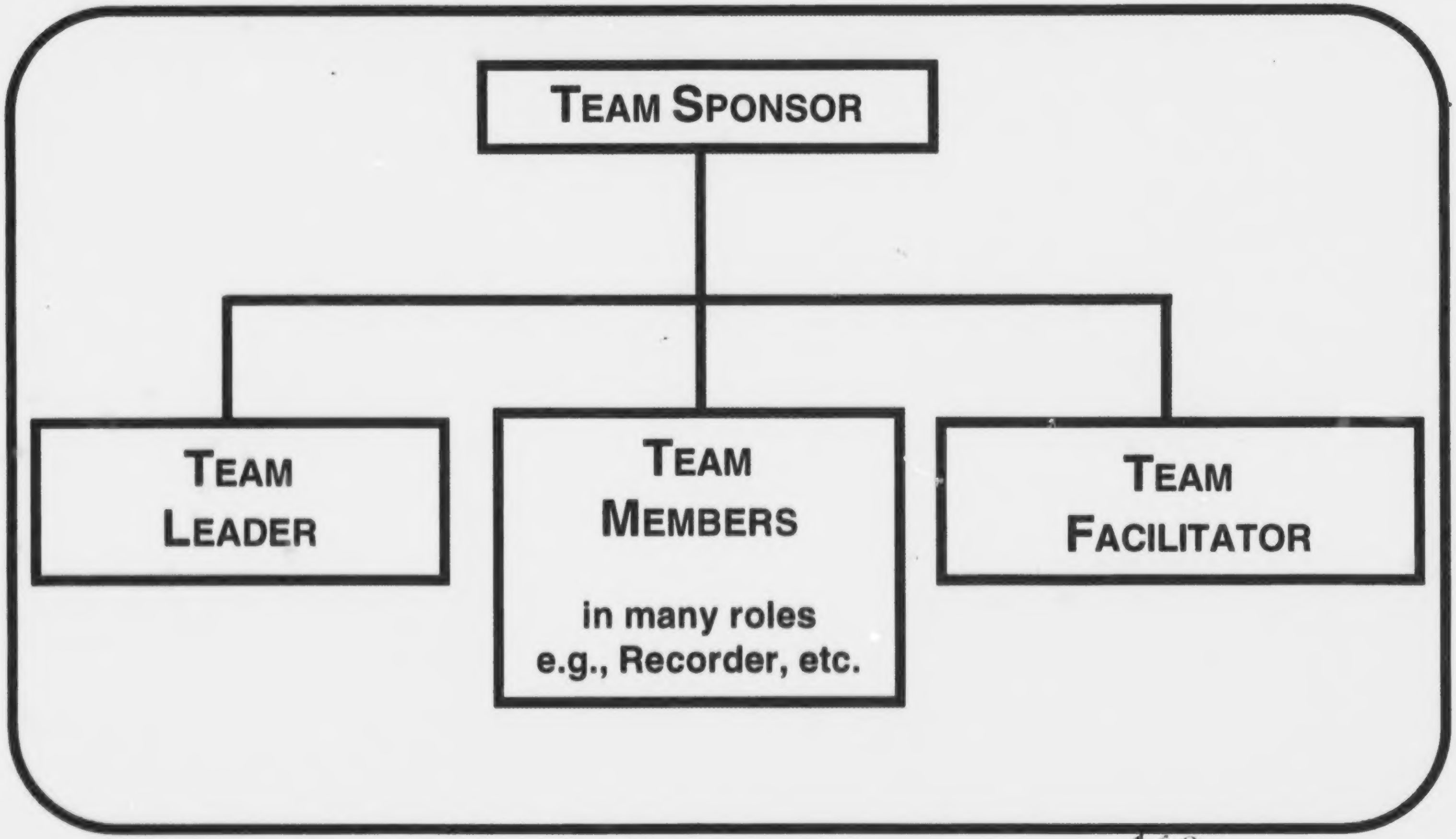
Topic for Expert Table 2

Team Composition and Roles

It is essential that the right people be assigned to the team. Each person should be selected based on his or her knowledge and expertise. In addition to selecting the appropriate people, there are also key roles that are essential to the overall team's success. Key roles include: leader, facilitator, member, sponsor, gatekeeper, recorder, timekeeper, devil's advocate. The particular responsibilities of several of these roles is discussed on the following pages.

Topic for Expert Table 2

TEAM ORGANIZATIONAL STRUCTURE



TEAM SPONSOR

TEAM LEADER

TEAM MEMBERS

in many roles
e.g., Recorder, etc.

TEAM FACILITATOR

Topic for Expert Table 2

Sponsor

The sponsor oversees and supports the activities of one or more project teams. Typically, these are the same managers who chose the projects and appointed the teams in the first place, but other people may be involved. Sponsors must have a stake in the chosen process; authority to make changes in the process under study; and clout and courage.

Sponsors do not conduct the actual project; they guide the efforts of the project team. They appoint the project team and together with the team leader determine the project's boundaries. They make certain the project team has whatever reasonable resources it needs to be successful. Sponsors must adjust workloads to make time for the project; don't expect team members to take on the project work as additional work.

The duties of the sponsor occur in two phases.

1. Before the project the sponsor should
    - Identify the project to be studied
    - Determine any boundaries or constraints
    - Select the project team
    - Assign the facilitator.
2. During the project, the sponsor
    - Meets regularly with the project team leader
    - Develops and improves systems that allow team members to bring about change.
    - When necessary, "runs interference" for the project team, representing its interests to the rest of the organization.
    - Insures that changes made by the team are followed up; implements changes the project team is not authorized to make.

The responsibilities of the sponsor are not finished until these changes are introduced, the improvements accomplished, or the new methods systematized and the project officially completed. This may take from several weeks to over a year.

Topic for Expert Table 2

Team Leader

The team leader is the person who manages the team: calling and, if necessary, facilitating meetings, handling or assigning administrative details, orchestrating all team activities, and overseeing preparations for reports and presentations. The team leader should be interested in solving the problems that prompted this project, and be reasonably good at working with individuals and groups. Ultimately it is the leader's responsibility to create and maintain channels that enable team members to do their work.

Team leaders can be appointed by the sponsor or selected by the team itself. If the team leader is a supervisor or manager in the project area, he or she must take extra precautions to avoid dominating the group during meetings. The leader leaves rank outside the meeting room, facilitating discussions and actively participating but as an equal member of the team.

The team leader

- Is the contact point for communication between the team and the rest of the organization, including the sponsor.
- Is the official keeper of the team records, including copies of correspondence; records of meetings and presentations; meeting minutes and agendas; and charts, graphs, and other data related to the project.
- Is a full-fledged team member. As such, the team leader's duties also include attending meetings, carrying out assignments between meetings, and generally sharing in the team's work.
- Assists the team with immediately implementing changes that are within the bounds of the team. Changes beyond these bounds must be referred to the sponsor or other appropriate level of management.

Topic for Expert Table 2

Facilitator

The ideal facilitator has a combination of people, technical, and training skills--talents not often found together. Facilitators should be chosen from outside the process area being studied so that they are neutral to the project.

Facilitators attend team meetings but are neither leaders nor team members. They are "outsiders" to the team, and maintain a neutral position. One of their most important jobs arising from this neutrality is to observe the team's progress, evaluating how the team functions, and use these observations to help the team improve its process (how members interact both inside and outside of meetings).

The facilitator:

- Focuses on the team's process more than its product; is concerned more with how decisions are made than what decisions are reached.
- Works with the team leader between meetings to plan for upcoming meetings.
- Continually develops personal skills in facilitating, group processes, and planning. Learns a variety of techniques to control digressive, difficult, or dominating participants, to encourage reluctant participants, and to resolve conflict among participants. Learns when and how to employ these interventions and how to teach such skills to team members.
- Helps project teams design and, sometimes, rehearse presentations to management.

Topic for Expert Table 2

Team Member

Team members--typically five to seven per project--are the rest of the people involved in the project. Not everyone who could contribute something worthwhile need be on the team; project team members can always consult with experts, other staff, or others as the project unfolds.

Team members are appointed by the sponsor. The nature of the project dictates who they are: usually people who work closely with some aspect of the process under study; often representing different stages of the process and groups likely to be affected by the project. They can be of various ranks, professions, trades, classifications, shifts or work areas (if the project cuts across division boundaries, so should team membership).

Team members

- Should remember that management has indicated their support for the project by setting up the project team. **Therefore, team members should consider their participation as a priority responsibility, not an intrusion on their real jobs.**
- Are responsible for contributing as fully to the project as possible, sharing their knowledge and expertise, participating in all meetings and discussions, even on topics outside their areas.
- Carry out their assignments between meetings: interviewing other employees or customers, observing processes, gathering data, writing reports, and so on. These tasks will be selected and planned at the meetings.
- Should be open minded about others' ideas, share information, and contribute constructively to the team process.

Topic for Expert Table 2

Miscellaneous

- Recorder
  The recorder is the team member who is responsible for making sure that the process(es) being used by the group are documented. This includes writing down all the important points of a discussion and preparing the minutes of a meeting. S/he is also responsible for preparing slides and reports which the team needs.
- Time Keeper
  The time keeper has the responsibility of keeping the team moving so that they finish the task at hand.
- Encourager
  The encourager has the task of giving encouragement to all the other team members. When a team member makes a contribution, the encourager can comment “good idea” or “nice thought”, etc.
- Devil’s Advocate
  The devil’s advocate takes a position opposite to that held by the team to ensure that all sides of an issue are considered.
- Gatekeeper
  The gatekeeper (a role sometimes• also taken by the facilitator or team leader) as the responsibility of maintaining a balanced level of participation for all the members. S/he will encourage the silent members and try to hold back the verbose, dominate members. A team functions when all members• ideas and thoughts are heard - the gatekeeper helps ensure this.

Topic for Expert Table 2

Characteristics of a Good Team Leader

- Is energetic
- Is skilled at resolving conflict
- Is well organized
- Has experience as a group leader
- Is respected by group members
- Is reliable
- Is charismatic
- Is intelligent
- Is creative
- Possesses a sense of humor
- Is effective in achieving results

Topic for Expert Table 2

Characteristics of a Good Team Member

- Works for consensus on decisions
- Shares openly and authentically with others regarding personal feelings, opinions, thoughts, and perceptions about problems and conditions
- Involves others in the decision-making process
- Trusts, supports, and has genuine concern for other team members.
- "Owns" problems rather than blaming them on others
- When listening, attempts to hear and interpret communication from other's points of view
- Influences others by involving them in the issue(s)

Topic for Expert Table 2

Characteristics of a Good Team Member, cont.

- Encourages the development of other team members
- Respects and is tolerant of individual differences
- Acknowledges and works through conflict openly
- Considers and uses new ideas and suggestions from others
- Encourages feedback on own behavior
- Understands and is committed to team objectives.
- Does not engage in win/lose activities with other team members
- Has skills in understanding what's going on in the group

Topic for Expert Table 3

Stages of Team Development (from Forsyth, 1990)

Theory on team development predicts that teams, like individuals, pass through predictable, sequential stages over time. The most well known of these models is that of Tuckman (1965), who labeled the stages of team development as forming, storming, norming, performing, and adjourning.

Forming (the orientation stage)
Members of newly formed teams often feel anxious and uncomfortable. They must interact with other individuals whom they do not know well and begin to work on tasks which they may not yet completely understand. Their roles in the team and the procedures for interaction may be ambiguous as well. As members become better acquainted, some of the tension may dissipate. Members will begin to become more comfortable with their roles.

Storming (the conflict stage)
The polite interactions of the orientation stage may soon be replaced by conflict. False conflicts occur when members misunderstand or misinterpret each others behaviors. Contingent conflicts develop over procedural or situational factors (such as meeting times, places, or formats). These two types of conflict are relatively easy to resolve, whereas escalating conflicts, a third variety, may cause more serious problems for the team. Escalating conflicts may begin as simple disagreements which then lead into the expression of more fundamental differences of opinion. Such conflicts may be characterized by venting personal hostilities and the expression of long suppressed emotions or ideas. Although conflict may damage or destroy a team, most researchers agree that conflict is a natural consequence of team membership, and that it may, in fact, strengthen the team as the members learn to accept and constructively resolve their differences.

Topic for Expert Table 3

Stages of Team Development (continued)

Norming (the cohesion stage)
During the third stage, team conflict is replaced by a feeling of cohesiveness. Teams experience a sense of unity or team identity. Membership stability also characterizes this stage. Members are highly involved and turnover is low. An increase in member satisfaction also happens at this time. Not only are members pleased with the team, but they themselves may experience higher self esteem and lower anxiety as a result of their participation in the team. The internal dynamics of cohesive teams change as well. Individual members are more likely to accept or be persuaded by team norms. One negative aspect of this is that, in some teams, dissent may not be tolerated during this stage.

Performing (the task-performance stage)
High productivity is most likely when teams have been together for some time. Whether the focus of the team is task oriented or therapeutic, effective performance occurs late in the developmental life of the team. Although, as a rule, non-cohesive teams are less productive than cohesive teams, not all cohesive teams are productive. Some cohesive teams may have strong norms which encourage low productivity.

Adjourning (the dissolution stage)
Teams may adjourn spontaneously or by design. Planned dissolution occurs when the team has completed its task or exhausted its resources. Spontaneous dissolution occurs when members are unable to resolve conflicts, its members grow dissatisfied and depart, or when repeated failure makes the team unable to continue. Either type of dissolution may be stressful. Members of successful teams may not want to end, and when the dissolution is unexpected, members may experience a great deal of conflict or anxiety.

Topic for Expert Table 3

Stages of Team Development (continued)

Stage	Major Processes	Characteristics
1. Forming (orientation)	Exchange of information; increased interdependency; task exploration; identification of commonalities	Tentative interactions; polite discourse; concern over ambiguity; self-discourse
2. Storming (conflict)	Disagreement over procedures; expression of dissatisfaction; emotional responses; resistance	Criticism of ideas; poor attendance; hostility; polarization and coalition forming
3. Norming (cohesion)	Growth of cohesiveness and unity; establishment of roles, standards, and relationships	Agreement on procedures; reduction in role ambiguity; increased "we-feeling"
4. Performing (performance)	Goal achievement; high task orientation; emphasis on performance and production	Decision making; problem solving; mutual cooperation
5. Adjourning (dissolution)	Termination of roles; completion of tasks; reduction of dependency	Disintegration and withdrawal;increased independence and emotionality; regret

Topic for Expert Table 3

Recurring Phases in Task Performing Teams

As teams perform, even those that have reached the performing stage in Tuckman's (1965) model of team development, they must shift between two different orientations, or phases, to be highly productive. When a team directs attention at its primary task, it is almost inevitable that fatigue, tension, and conflict will develop.

Fatigue will set in if the task is demanding, or boredom will develop if it is too easy. Tension and conflict will develop when alternative approaches to task performance are suggested, or when alternative solutions to a team problem are put forward and discussed. As these products of a task orientation develop and increase, team productivity suffers. It is then important for the team to shift to a team maintenance orientation. This is accomplished by setting the task aside and focusing on the relationships between members, resting, reducing tension, and resolving interpersonal conflicts.

In many teams there is a "rush to performance" in which the stages of team development are side-stepped or truncated. In many ways, the stages of team development prepare members with the skills required during team maintenance activities. But it is also important that members acknowledge the legitimacy, even the necessity, of taking time away from the task to deal with team maintenance issues. Two separate leadership roles may develop within a team, one person who directs task activities, and another who is the team maintenance specialist.

Topic for Expert Table 3

Recurring Phases (continued)

Here are some of the functions necessary for task performance:

- Analysis of problem or task structure
- Suggesting solutions
- Asking for information
- Summarizing
- Delegating
- Refocusing team on task
- Pushing for a team decision
- other task functions, from your experience -
    1.
    2.

Here are some functions necessary for team maintenance:

- Telling a joke
- Mediating a conflict between team members
- Encouraging all to participate
- Showing approval
- Suggesting a break from work
- Reminding members of norms for cooperation
- Encouraging and modeling positive affect for team members
- other team maintenance functions, from your experience -
    1.
    2.

Topic for Expert Table 3

Recurring Phases (continued)

Team Maintenance

At various points in a team's history, there may be a need for team maintenance requiring various levels of intervention. There are three levels of intervention.

Levels of Intervention

- Prevention

  Set the teams up for success

- Mild Intervention

  Impersonal, group time

  Private, non-meeting time conversation

- Strong Intervention

  Private, non-meeting time confrontation

  Personal, group time

Topic for Expert Table 3

Ten Common Team Problems

1. Floundering
2. Overbearing participants
3. Dominating participants
4. Reluctant participants
5. Unquestioned acceptance of opinions as facts
6. Rush to accomplishment
7. Attribution
8. Discounts and "plops"
9. Wanderlust: digression and tangents
10. Feuding members

From Scholtes, Peter R., The Team Handbook, Joiner Associates (1988)

Six Types of Team Decisions

As a team works at a task, or even at team maintenance functions, decisions must be made. The quality of team decision making, and the extent to which a decision is accepted and implemented by team members, is greatly affected by the decision making process. Here are the six most common team decision making patterns.

1. **Unilateral/Authoritarian**
One person makes the decision and imposes it upon the team. Often, there is very little input from team members, and acceptance/commitment is low.

2. **Handclasp**
Two team members make a decision and impose it upon the team. This pattern sometimes looks participatory, but still elicits little input from the other members, who will have a low level of commitment to the decision.

3. **Minority**
Several members make a decision and impose it upon the majority, who have been disenfranchised. In the hands of skilled practitioners, this can look like participatory decision making, but it is only a handclasp among a few members. Decision quality suffers because of the lack of input from the majority, and commitment to the decision is low among those outside the minority.

Topic for Expert Table 4

Team Decisions (continued)

4. **Majority**

This is the popular, "democratic" default option. When a team is unable to resolve a conflict, there is almost always a suggestion to "take a vote, majority wins." Majority rule has the illusion of fairness, but it cuts off discussion, thereby reducing decision quality. It also elicits no commitment to the decision from the losing minority. The "loyal opposition" is often a myth. Super-majorities of 2/3 or 3/4 do not solve the problems associated with voting.

5. **Unanimity**

Solves the problem of commitment, but is very cumbersome because now everyone has a veto. The U. N. Security Council is a good (horrible?) example

6. **Consensus**

Difficult to achieve, but results in the best decision quality and the highest level of commitment to the team decision. The alternatives are discussed and refined until a consensus is attained. That may mean that no one gets exactly what he or she wanted, but everyone is able to say, "I might take a different course of action if it were entirely up to me, but I commit my support to the plan we have all agreed upon." Achieving consensus involves compromise on the part of all members, but it is each member's responsibility to present her/his position as effectively as possible. Only then does consensus lead to high quality decisions.

Topic for Expert Table 4

Sources of Power in Teams

The ability of an individual to influence others within the context of a small, task-oriented team is determined by the power of that individual. There are five sources of social power; some are more effective than others.

1. **Legitimate Power**. This power results from the position the person holds. A designated or elected leader, a military commander, a manager, all have legitimate power, power that is inherent in the position. Generally, influence based on legitimate power will be accepted by team members, but it is important that they accept the legitimacy of the power hierarchy.

2. **Reward Power**. This power is based on the ability of the person to control important sources of reward and reinforcement. Salary, bonuses, time off, access to resources, are all rewards that can be used to influence behavior. Reward power is usually well accepted by team members if the rewards are administered within clear contingencies and guidelines.

3. **Coercive Power**. This is the power to administer punishment for noncompliance. Fines, suspensions, undesirable assignments, verbal abuse, ridicule, are all examples of punishment or coercive power. The application of coercive power usually leads to compliance, but also generates resentment, negative emotionality, and dislike for the person who employs it.

Topic for Expert Table 4

Sources of Power in Teams (continued)

4. **Expert Power**. This form of power is based on the knowledge, special skill, training, or experience of the person. When a person's expertise is known to the team, influence within that area of expertise is well accepted. The user of expert power must find a balance between being haughty and being too humble. Bragging about your skills doesn't establish useful expert power, but expert power can't be used if no one knows about it.

5. **Referent Power**. This is power based on the person's attractiveness and qualities as a human being. It is called "Referent" because teams members use this person as a point of reference in developing their own personalities. Referent power depends upon developing positive relationships with team members. It is not simply mutual attraction, but a relationship that includes a kind of mentoring and guidance that is possible because one person wants to learn from the other.

The use of power in teams is an ongoing process. The sources of power that are most useful to leaders and facilitators are expert power and referent power. They produce influence and change in a positive way, and minimize resistance and negativity. Reward and legitimate power can also be used effectively and in a positive way. Coercive power often quickly produces the desired behavior, but leads to other, undesirable consequences.

Topic for Expert Table 5

Five Issues to be Considered in Team Building

Team building exercises are very important in the development of task-oriented teams that will work together for an extended period of time on a complex project. Experiences designed to facilitate team development should be focused on some, if not all, of five issues, which follow on the next pages.

1. **Interdependence**
This is the issue of how each member's outcomes are determined, at least in part, by the actions of the other members. The structure of the team task should be such that it requires cooperative interdependence. Functioning independently of other team members, or competing with them should lead to sub optimal outcomes for the entire team. The team building task should also have such a structure. Tasks that require the successful performance of sub tasks by all team members are called divisible, conjunctive tasks. The team building exercise should be structured so that the team becomes aware of, and experiences their interdependence.

2. **Goal Specification**
It is very important for team members to have common goals for team achievement, as well as to communicate clearly about individual goals they may have. Some team building sessions consist entirely of goal clarification exercises. The process of clarifying goals may well engage all of the issues on this list. Indeed, shared goals is one of the definitional properties of the concept "team." A simple, but useful, team building task is to assign a newly formed team the task of producing a mission and goals statement.

Topic for Expert Table 5

Five Issues (continued)

3. **Cohesiveness**

This term refers to the attractiveness of team membership. Teams are cohesive to the extent that membership in them is positively valued; members are drawn toward the team. In task oriented teams the concept can be differentiated into two sub concepts, social cohesiveness and task cohesiveness. Social cohesiveness refers to the bonds of interpersonal attraction that link team members. Although a high level of social cohesiveness may make team life more pleasant, it is not highly related to team performance. Nevertheless, the patterns of interpersonal attraction within a team are a very prominent concern. Team building exercises that have a component of fun or play are useful in allowing attraction bonds to develop. Task cohesiveness refers to the way in which skills and abilities of the team members mesh to allow effective performance. Exercises that require the application of the skills that will be necessary for completion of the team assignment, but require them in a less demanding situation, allow the team members to assess one another's talents. Such experiences can lead to consideration of the next issue, the development of team member's roles and of the norms that govern role enactment.

Topic for Expert Table 5

Five Issues (continued)

4. **Roles and Norms**
All teams develop a set of roles and norms over time. In task oriented teams, it is essential that the role structure enables the team to cope effectively with the requirements of the task. When the task is divisible and conjunctive, as are most of the important team tasks in our society, the assignment of roles to members who can perform them effectively is essential. Active consideration of the role structure can be an important part of a team building exercise. Task roles may be rotated so that all team members experience, and learn from, all roles. Even then, it is important that the norm governing the assignment of roles is understood and accepted by team members.

Norms are the rules governing the behavior of team members, and include the rewards for behaving in accord with normative requirements, as well as the sanctions for norm violations. Norms will develop in a team, whether or not they are actively discussed. There are common norms that govern most teams but that does not preclude a team building assignment in which those norms, as well as some that are specific to a team, are discussed and accepted.

Topic for Expert Table 5

Five Issues (continued)

5. **Communication**
Effective interpersonal communication is vital to the smooth functioning of any task team. There are many ways of facilitating the learning of effective communication skills. Active listening exercises, practice in giving and receiving feedback, practice in checking for comprehension of verbal messages, are all aimed at developing skills. It is also important for a team to develop an effective communication network; who communicates to whom; is there anybody "out of the loop?" Norms will develop governing communication. Do those norms encourage everyone to participate, or do they allow one or two dominant members to claim all the "air time?" Team building exercises can focus on skill development, network design, and norms, but even when the exercise is focused on another issue, communication is happening. Watch it! Shape it!

Summary:
These issues are not intended to present a series of team building exercises. Rather, they are intended to help you evaluate the potential effectiveness of an exercise you design, or one that you find in the numerous sources available. Team building is not a silver bullet for fixing dysfunctional teams, or assuring that all of your teams will work well. Team building exercises can be helpful in developing effective task-oriented teams, if they are selected to enable teams to explore the issues identified in this outline.

E - 33

Process Check

- Monitoring of processes, especially processes which you own or are a part of, is necessary if improvement is desired
- A process check is a formalized way to do this monitoring and should be used at the end of all process related activities
- There are many different ways to conduct a process check
- A process check must focus on the process
- Failure of a process does not infer any judgment about the quality of the team members

E - 34

Process Check : Plus / Delta

- On one 'postit', place a + at the top and write a BRIEF comment below about ONE thing you found valuable and would keep for future sessions.

- On a second 'postit', place a Δ at the top and write a BRIEF suggestion below about how to improve ONE thing for future sessions.

- Post the notes in the place designated by the workshop facilitator when you are finished.

Process Check : Jigsaw
(15 minutes)

	AGREE			DISAGREE	
The team now knows the importance of teams	1	2	3	4	5
As a member of this team, I now know about:					
Productive Meetings	1	2	3	4	5
Team Composition and Roles	1	2	3	4	5
Stages of team development	1	2	3	4	5
Team decisions	1	2	3	4	5
Consensus and GroupNOthink	1	2	3	4	5
Recurring phases in team functioning	1	2	3	4	5
Sources of power in teams	1	2	3	4	5
Issues in team building	1	2	3	4	5
All team members participated	1	2	3	4	5
The team stayed focused on task	1	2	3	4	5

Reflection (the Academic Journal)

What is a Journal? A journal is a place to practice writing and thinking. It differs from a diary in that it should not be merely a personal recording of the day's events. It differs from your class notebook in that it should not be merely an objective recording of academic data. Think of your journal rather as a personal record of your educational experience, including this class, other classes, and your current extracurricular life..

What to Write. Use your journal to record personal reactions to class, topics, students, teachers. Make notes to yourself about ideas, theories, concepts, problems. Record your thoughts, feelings, moods, experiences. Use your journal to argue with the ideas and readings in the course and to argue with me, express confusion, and explore possible approaches to problems in the course.

When to Write. Try to write in your journal at least three or four times a week (aside from your classroom entries). It is important to develop the *habit* of using your journal even when you are not in an academic environment. Good ideas, questions, etc. don't always wait for convenient times for you to record them.

How to Write. You should write however you feel like writing. The point is to think on paper without worrying about the mechanics of writing. The quantity you write is as important as the quality. Use language that expresses your personal voice -- language that comes natural to you.

Reflection
(the Academic Journal continued)

Suggestions:

1. Chose a notebook you are comfortable with' I recommend a small (6" x 9") looseleaf.
2. Date each entry; include time of day.
3. Don't hesitate to write long entries and develop your thoughts as fully as possible.
4. Use a pen (pencils smear, but are ok if you prefer them).
5. Use a new page for each new entry.
6. Include both "academic" and "personal" entries; mixed or separate as you like.

Interaction -- Professor. I'll ask to see your journal at least twice during the term; I'll read selected entries and, upon occasion, argue with you or comment on your comments. Mark any entry that you *don't want me to read* and I'll honor your privacy. None of the dialogue with you will affect how much your journal is "worth." A *good* journal will be full of lots of long entries and reflect active, regular use.

Interaction -- Corespondent. Choose a colleague (a fellow student in your group, for example) to read and respond to your journal entries.

Adapted by Karl Smith from Fulwiler, T. *Teaching with writing.* Portsmouth, NH; Boynton/Cook, 1987.

ECTION F
Norms & Communication

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Learning a Process for Maintaining an Effective Team

F-1

In this session, we will learn and practice a process for improving and maintaining the communication skills of the team. All of the issues and problems that can and do arise as a natural consequence of using teams need to be addressed by the team; preferably using a standard process. The process presented in this session includes the development of 'social norms' which can be used to reduce, if not eliminate, the impact of these issues and problems on team performance. This is your opportunity to learn how to effectively (or affectively) address many of your past complaints about working in groups; e.g., 'He is always late or skips scheduled meetings.', 'She is never prepared.', 'She never completes his part of the problem or assignment', 'He always wants to copy my work and that's cheating', etc. Many of these behaviors were illustrated in the two videos used in this class. Please do your best today to develop an understanding of this process. I want you to keep an open mind about the process and, hopefully, learn to use it to develop a culture in your team that is harmonious and cohesive as well as productive ! Working in 'real' teams can be fun !

NOTE: Social norms are the agreed upon behaviors, attitudes, values, etc. which hold 'society' in general and teams in particular together. These may be implicit or explicit but they MUST be commonly understood, reinforced, and taught (N.B. In the team environment, they also MUST be EXPLICIT, reinforced and learned by all team members.). Sociologists believe that it is upon the 'norms' that a society is built. They see these 'norms' as the 'glue' which holds society (culture, subculture, team, etc.) together . When establishing a team, the Code of Cooperation is one way to explicitly develop norms and serves to create a basis for organization and social interaction. When agreed upon norms start to fall apart or people disregard them and there is nothing to take their place, there ceases to be cohesiveness. The disintegration of norms creates disorganization which may lead to a state of anomie. Then you are really in trouble!

Communication Skills & Norms : Session Structure

F-2

- Lecturette (15 minutes)
- View a video; look for examples (25 minutes)
- Break (until the next class period)
- Promoters & Barriers to Effective Communication (25 minutes)
- Developing Norms (35 minutes)
- Break (10 minutes)
- Practicing Constructive Feedback (15 minutes)
- Session Process Check (+/delta, 5 minutes)
- Academic Journal Entry (10 minutes)

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Ten Commandments*

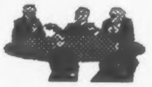
F-3

1. Help each other be right, not wrong.
2. Look for ways to make new ideas work, not for reasons they won't.
3. If in doubt, check it out! Don't make negative assumptions about each other.
4. Help each other win, and take pride in each other's victories.
5. Speak positively about each other and about your organization at every opportunity.
6. Maintain a positive mental attitude no matter what the circumstances
7. Act with initiative and courage, as if it all depends on you.
8. Do everything with enthusiasm; it's contagious.
9. Whatever you want; give it away.
10. Don't lose faith.
11. Have fun!

Consensus

F-4

an agreed upon decision by all team members that reflects full exploration of a decision issue and does not compromise any strong convictions or needs ... ***often becomes new policy***



Adapted from Boeing Commercial Airplane Group Training Materials

F - 5

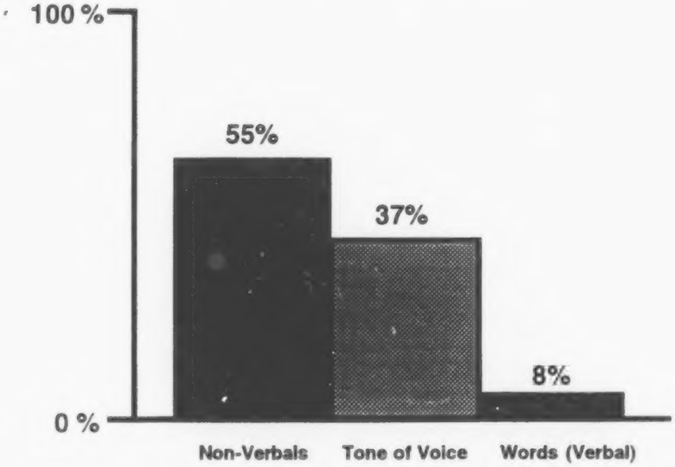
OVERCOMING
GROUP NO THINK

- De-emphasize status and power differences between members.
- Welcome outside viewpoints.
- Encourage disagreement or clash of opinions.
- Assign one member the task of being a devil's advocate.

Adapted from Boeing Commercial Airplane Group Training Materials

F - 6

Face-To-Face Communication

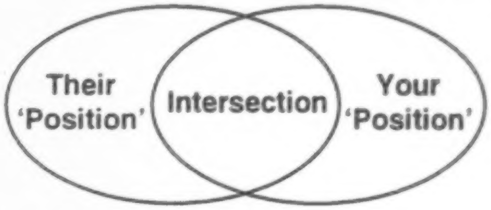


COMMUNICATION ROADBLOCKS

- **Directing**
- **Interrupting**
- **Judging**
- **Name Calling**

- **Moralizing**
- **Persuading**
- **Ridiculing**
- **Warning**

FIRST Seek the 'Intersection'



Their 'Position'

Intersection

Your 'Position'

- ❖ First, see the problem from the other point of view ; really seek FIRST to understand !
- ❖ Second, identify the 'Intersection'
  (i.e., where the 'positions' clearly overlap).
- ❖ Finally, select ONE issue at a time from outside the 'Intersection' to discuss and resolve.
  - Select the issues that are 'closest' to the 'Intersection' and work 'outwards' from there : alternating between 'their position' and 'your position'.

Listening Skills

F - 9

- ❖ Stop talking.
- ❖ Engage in one conversation at a time.
- ❖ Empathize with the person speaking.
- ❖ Ask questions.
- ❖ Don't interrupt.
- ❖ Show interest.
- ❖ Concentrate on what is being said.
- ❖ Don't jump to conclusions.
- ❖ Control your anger.
- ❖ React to ideas, not to the speaker.
- ❖ Listen for what is not said. Ask questions.
- ❖ Share the responsibility for communication.

Listening Techniques

F - 10

- ❖ Critical Listening
  - Separate fact from opinion.
- ❖ Sympathetic Listening
  - Don't talk - listen.
  - Don't give advice - listen.
  - Don't judge - listen.
- ❖ Creative Listening
  - Exercise an open mind.
  - Supplement your ideas with another person's ideas and vice versa.

Paraphrase for Understanding

F - 11

Seek First to Understand, Then to be Understood *

- ❖ Often we are either speaking or preparing to speak with the clear intent to reply, no?
- ❖ Try listening with the *intent to paraphrase* what is being *said by the other person.*
- ❖ To improve your understanding and to promote true consensus, paraphrase what was said by the speaker
  - *until the speaker agrees with your paraphrase* !
- ❖ Then, thoughtfully prepare and deliver your response.
- ❖ This is often referred to as 'empathic listening'.

* Covey, Stephen R., The 7 Habits of Highly Effective People, (1989), Simon & Schuster, Habits 4 and 5.

Talking Chips *

F - 12

- ❖ Each person selects one 'totem' (your pen is fine).
- ❖ If you want to talk, place your 'totem' in the center of the table (or out in front of you).
- ❖ First come first talk, so to speak.
- ❖ While your 'totem' is still in the center of the table, you can not talk again until
  - everyone's 'totem' is in the center of the table

    OR
  - the current discussion topic is completed.
- ❖ When all of the 'totems' have been used or the current discussion topic is complete, the 'totems' are retrieved and the process begins anew.

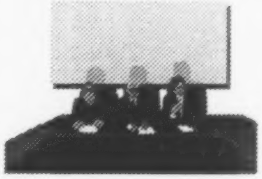
* Spencer Kagan describes a number of 'communication regulators' including Talking Chips, Colored Chips, Response Mode Chips, and Paraphrase Passport in Chapter 13 of his book, Cooperative Learning (1992, San Juan Capistrano, CA: Resources for Teachers)

F - 13

Constructive Feedback

is…

- ❖ Communication to a person (or group) regarding the effect that a person's behavior has on another person or on the group
- ❖ Perceptions, feelings, and reactions to the message



F - 14

Constructive Feedback

- ❖ You are an expert on
  - other people's behavior
  - your feelings
- ❖ You are **NOT** an expert on
  - your behavior
  - other people's feelings

How to Give Constructive Feedback

F - 15

1. "When you . . ."	Start with a "When you . . ." statement that describes the behavior without judgment, exaggeration, labeling, attribution, or motives. Just state the facts as specifically as possible.
2. "I feel . . ."	Tell how their behavior affects you. If you need more than a word or two to describe the feeling, it's probably just some variation of joy, sorrow, anger, or fear.
3. "Because I . . ."	Now say why you are affected that way. Describe the connection between the facts you observed and the feelings they provoke in you.

From Scholtes, Peter R., The Team Handbook, Joiner Associates (1988)

How to Give Constructive Feedback (cont.)

F - 16

4. (Pause for Discussion)	Let the other person respond.
5. "I would like . . ."	Describe the change you want the other person to consider ...
6. "Because . . ."	... and why you think the change will alleviate the problem.
7. "What do you think . . ."	Listen to the other person's response. Be prepared to discuss options and reach consensus on a solution.

How to Give Constructive Feedback Example

F - 17

1. **"When you . . ."**	"When you are late for team meetings,
2. **"I feel . . ."**	I get angry ...
3. **"Because I . . ."**	... because I think it is wasting the time of all the other team members and we are never able to get through all of the agenda items."
4. **(Pause for Discussion)**	...
5. **"I would like . . ."**	"I would like you to consider finding some way of planning your schedule that lets you get to these team meetings on time. "
6. **"Because . . ."**	"Because that way we can be more productive at the team meetings and we can all keep to our tight schedules."
7. **"What do you think . . ."**	

To Realize the Benefits of a Team Culture Requires a Change in Management Behavior

F - 18

FROM		*TO*
Directing	→	Guiding
Competing	→	Collaborating
Relying on Rules	→	Focus on the Process
Using Organizational Hierarchy	→	Using a Network
Consistency/Sameness	→	Diversity/Flexibility
Secrecy	→	Openness/Sharing
Passive	→	Risk Taking
Isolated Decisions	→	Involvement of Others
People Costs	→	People Assets
Results Thinking	→	Process Thinking

F - 19

Promoters & Barriers of Effective Communication

❖ Goals

- Anticipating Potential Problems and Establishing Corrective Norms
- Make team members aware of what things bother other team members
- Organize potential problems into major groups
- Develop a strategy for addressing potential teaming problems
- Develop a knowledge of Team Processing Tools (see the Appendix for detailed information)

F - 20

Force Field Analysis

Purpose

A force field analysis helps teams find out what is driving, slowing, or not allowing change. The tool helps a team to work together, to find a starting point from which to take action, and to show both sides of the change issue.

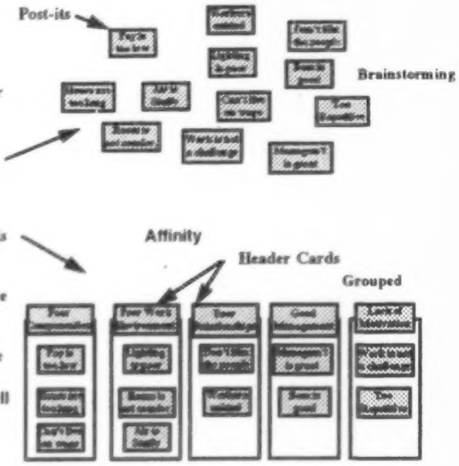
Steps

1. On a board or large piece of paper draw a vertical line down the middle and a horizontal line across the paper near the top
2. Label the left column Promoting and the right column Preventing
3. Brainstorm entries for the left hand column.
4. Brainstorm entries for the right hand column.

Promoting	Preventing

Brainstorming and Affinity Processes

- **Purpose:**
- **To organize a large set of items into a smaller set of related items.**
- **Guidelines:**
- **The rules of brainstorming are followed but each idea is written (in 7 words or less, including a noun and a verb) on a self-adhesive Post-it note or card**
- **Team members *silently* move the Post-it cards around to form closely-related idea groups**
- **If disagreement exists when grouping, make copies of the contested card and place in more than one group**
- **Label each group with a *header card* which clearly identifies and reflects the theme of the cards**
- **If there are single idea cards that don't fit well with the other ideas, have the team decide if they should be kept (they may be excellent ideas thought of only by one person)**



Modified Nominal Group Technique

Purpose

Modified nominal group technique is a technique to help a team or group quickly reduce a large list of items to a smaller number of high priority items. The process elicits a high degree of team agreement and promotes team ownership. This tool is similar to nominal group technique but not quite as involved.

Steps

Step 1

Count the number of items on the list and divide by three. This is the number of votes each person has. (Round fractions off to the lower number.) If the items number more than 60, do not go over a vote total of 20. Vote totals of more than 20 are hard to manage. Give each team member as many colored dots as she/he has votes.

Step 2

Have each person use his/her votes (colored dots) to select the items he/she wants to keep. While each person can vote for any item, it is a good idea to limit the number of votes any one item can receive from a single person to three. Note: the team can decide if they want to allow more or less multiple voting.

Step 3

List alternatives in their new prioritized order

Step 4

Critically discuss the top alternatives in order to reach consensus. Eliminate those that are outside the control of the team

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SECTION G
Tool Box

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Tools Useful in Team Processing

A number of tools have been developed to provide a structure which facilitates team discussion, exploration of ideas, and decision making. Examples include:

Seven Planning Tools of the Quality Movement

- Activity Network Diagram
- Interrelationship Digraph **
- Prioritization Matrix **
- Tree Diagram **
- Affinity Diagram **
- Matrix Diagram **
- Process Decision Program Chart

Others

- McNeill's Agenda Planner **
- Consensogram
- Fishbone Diagram
- Histograms
- Integrative Analysis Diagram
- Multivoting **
- Pareto Chart
- Process Check **
- Run Charts
- Brainstorming **
- Deployment Flow Chart **
- Force Field Analysis **
- Impact/Changeability (9-Square) **
- Issue Bin **
- Nominal Group Technique **
- P.E.R.T. Chart
- Radar Chart
- Stability Chart

** Information is in this workbook

Source: The Memory JoggerPlus+, GOAL/QPC, 13 Branch Street, Methuen, MA 01844. 508-685-3900, Fax 508-685-6151

McNeill's Agenda Planner

Time Block (minutes) From To Duration	Details
Topic	
Participants	
Purpose Cognitive Goals	
Affective Goals	
Discussion Tools or Activity	
Required Reading or Preparation	
Visual/Audio /Other Aids/Equipment	

Meeting Date

Meeting Location

Team Leader

Team Recorder

Team Facilitator

Team Time Keeper

Team Devil's Advocate

Affinity Process

Purpose
To organize large sets of items (more than twenty items) into smaller sets of related items

Steps

1. The rules of brainstorming are followed but each idea is written (in seven words or less using a verb and a noun) on a self-adhesive Post-it note or card.

2. After all the ideas have been generated and entered on the Post-its, post all the Post-its on a wall or board. Discuss the Post-its to check if there are any questions about what any of the Post-its say or mean.

3. Team members now silently move the Post-it cards around, grouping cards which have an affinity, together.

4. If disagreement exists when grouping, make copies of the contested card and place in more than one group.

5. When the grouping has stopped, discuss each grouping to determine what it is that relates all the cards. Write a header card for each group which captures the theme and feeling of the cards.

6. If there are single idea cards that do not fit well with the other ideas, have the team decide if they should be kept.

Brainstorming

Purpose

To generate a high volume of ideas in a non-analytical manner which permits the ideas of one individual to stimulate the ideas of the other individuals in the team

Steps

1. Define and write out a question (topic) for which you desire a large number of answers
2. Silently generate and write down a list of ideas. When it seems most team members have stopped adding to their lists, share the lists and continue to generate ideas as they occur.
3. Record the information as given (i.e., do not paraphrase).
4. Do not criticize ideas or people.
5. Strive for fluency of ideas by building (piggybacking) on the given ideas.
6. Strive for a maximum number of ideas.
7. Strive for flexibility of ideas. Welcome wild ideas which can act as triggers to stimulate breakthroughs into new directions.

Steps in Creating a Deployment Flowchart

❖ 1. Identify steps for completing the process in the order they occur

❖ 2. Use flowcharting symbols to diagram the steps in the process

❖ 3. Connect the symbols with arrows indicating process flow

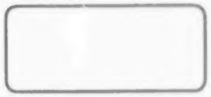
❖ 4. Rework the flowchart by adding the people dimension

❖ 5. Stretch meeting ovals to include all meeting participants

❖ 6. Draw rectangular symbols under person of primary responsibility - indicate input of others by use of circular symbols under their names connected with a line and arrow to the rectangular symbol

❖ 7. Place decision diamond-shaped symbols under individual involved in the decision process

Symbols Used in Flowchart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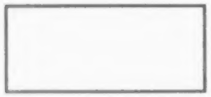
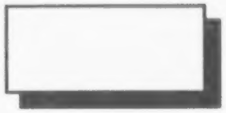
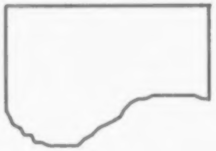
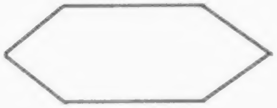
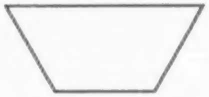
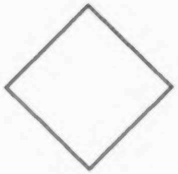

task

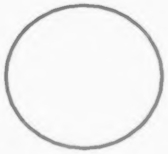

multiple task


document


standard process


termination
of process


decision


assistance or
involvement

Force Field Analysis

Purpose

A force field analysis helps teams find out what is driving, slowing, or not allowing change. The tool helps a team to work together, to find a starting point from which to take action, and to show both sides of the change issue.

Steps

1. On a board or large piece of paper draw a vertical line down the middle and a horizontal line across the paper near the top
2. Label the left column Promoting and the right column Preventing
3. Brainstorm entries for the left hand column.
4. Brainstorm entries for the right hand column.

Promoting	Preventing

Impact Changeability Analysis

Purpose

This tool helps prioritize a set of options

Steps

1. Review the tables on the next page for possible meanings of Impact and Changeability
2. Rank each option on impact and changeability using the following scales:

If option were implemented (or problem eliminated) what impact would this have?

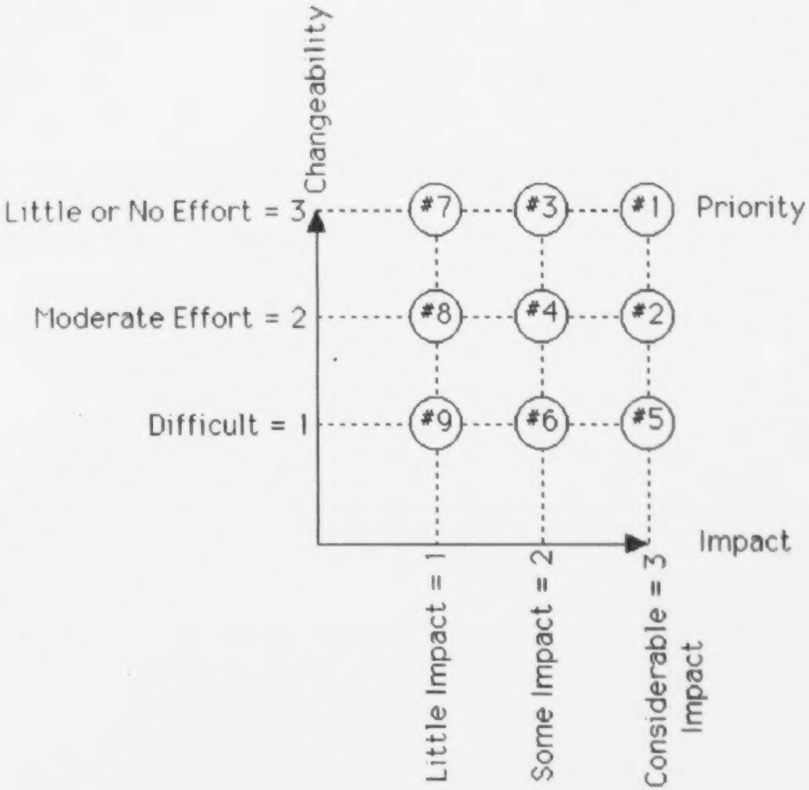
1 = Little Impact
2 = Some Impact
3= Considerable Impact

How difficult will it be to implement the option (or eliminate the problem)?

1 = Difficult
2 = Moderate Effort
3= Little or no Effort

3. Use the chart on the next page to determine the relative priority of the options.

Impact Changeability (cont.)


Changeability
Little or No Effort = 3
Moderate Effort = 2
Difficult = 1
#7
#3
#1
Priority
#8
#4
#2
#9
#6
#5
Impact
Little Impact = 1
Some Impact = 2
Considerable Impact = 3

Impact Considerations
- Effect on quality
- Time savings
- Material savings
- Morale
- Number of people who benefit

Changeability Considerations
- Resource requirements
- Complexity of investigation
- Time required
- Ability to measure outcomes
- Number of decision making levels required

Interrelational Digraph

Purpose

To help understand the interrelationships which exist among the various aspects of a problem and highlight potential root causes and bottlenecks

Steps

1. Select an appropriate issue (e.g., one that has at least fifteen interrelated issues which need to be better defined)
2. Generate the list of issues (e.g., brainstorm, header cards from Affinity Process, bones from a Fishbone Diagram), placing each issue on a 3 x 5 Post-it
3. Arrange the Post-its around the edge of a large circle, drawn either on a board or flip chart paper.
4. Number the Post-its, clockwise around the circle.
5. Starting with Post-it #1, ask the following question for each of the other Post-its: Does the issue listed on Post-it #1 influence or cause the issue listed on Post-it #n?
6. Whenever the answer to the question posed in 5 is yes draw an arrow from 1 to the Post-it which is influenced or caused by 1.
7. Repeat steps 5 & 6 using a different starting Post-it until all the Post-its have been used for starting the process.
8. Count the arrows leaving and entering the Post-its. Post-its which have a large number of arrows leading from the Post-it are potential Root Causes; while Post-its which have a large number of arrows leading to the Post-it are potential bottlenecks.

Matrix Diagram

Purpose

To help show relationships or requirements which exist among lists of items, requirements, criteria, resources, or people

Steps

1. Select an appropriate issue (e.g., one that has several lists of interrelated items)
2. Select the right type of matrix (e.g., an L matrix to relate two lists, a Y or T matrix to relate three lists, an X matrix to relate four lists)
3. Select an appropriate set of symbols and create a legend for the symbols, for example

◎	The two items are strongly related	P	This person has primary responsibility
○	The two items are somewhat related	S	This person has secondary responsibility
△	The two items are not related	△	This person needs to be kept informed

4. Fill in the matrix using the agreed upon symbols
5. Interpret the matrix (interpretation will depend on why matrix was created, e.g., are all tasks assigned, is there one issue that is strongly related to a number of items, etc.)

Modified Nominal Group Technique

Purpose

Modified nominal group technique is a technique to help a team or group quickly reduce a large list of items to a smaller number of high priority items. The process elicits a high degree of team agreement and promotes team ownership. This tool is similar to nominal group technique but not quite as involved.

Steps

Step 1

Count the number of items on the list and divide by three. This is the number of votes each person has. (Round fractions off to the lower number.) If the items number more than 60, do not go over a vote total of 20. Vote totals of more than 20 are hard to manage. Give each team member as many colored dots as she/he has votes.

Step 2

Have each person use his/her votes (colored dots) to select the items he/she wants to keep. While each person can vote for any item, it is a good idea to limit the number of votes any one item can receive from a single person to three. Note: the team can decide if they want to allow more or less multiple voting.

Step 3

List alternatives in their new prioritized order

Step 4

Critically discuss the top alternatives in order to reach consensus. Eliminate those that are outside the control of the team

Prioritization Matrix

Purpose

To prioritize tasks, issues, alternatives, etc. to aid in selecting what tasks, issues, alternatives to pursue

Steps

1. Generate a set of criteria to be used in establishing the quality of the decision
2. Construct an L matrix with options, etc. down the left and selection criteria across the top
3. Each person prioritizes the criteria by distributing the value 1.0 among the criteria (i.e., sum of weights is 1.0)
4. Sum the weights from each person for each criterion, the sum becomes the team's weight for the criterion. Enter these weights in the L matrix in brackets -- each column will have the same number in each cell.
5. Going a criterion at a time, rank order all the options, etc. with respect to the criterion using the modified nominal group technique. Enter the vote totals for each issue into the L matrix.
6. Find the product of the vote totals and weight for each issue and sum these products for each row.
7. The rows with the highest sums are the issues of highest priority. Be sure to discuss any row which has a low total but seems like it should be retained.

Full Analytical Criteria Prioritization Matrix

Purpose

To improve any decision making process by rationally prioritizing or ranking criteria (which will then be used to prioritize the tasks, issues, alternatives, etc.)

Steps

1. Generate a set of criteria to be used in making a 'quality' decision.
2. Construct an L matrix with criteria down the left side and criteria across the top.
3. Compare the criteria in EACH row with the criteria in EACH of the columns (i.e., a 'pairwise' comparison)
4. The Team should discuss each comparison and reach consensus on the relative importance of the two criteria. Avoid voting if at all possible.
5. Enter the appropriate word (e.g., =Same), or value, for the comparison in the appropriate ROW and COLUMN (e.g., R1 / C2).
6. Enter the RECIPROCAL of the word (e.g., =1/Same), or value, entered in 4. above in the corresponding COLUMN and ROW (e.g., R2 / C1).
7. Sum the numerical values in each row for each criterion. The sum becomes the team's weight for the criterion.
8. The rows with the highest sums are the criteria of highest priority. Be sure to discuss any row which has a low total but seems like it should be more important. Always review the numerical values to determine if they 'make sense' to the team!

Note at the bottom of p. 48 and again at the top of p. 67,
the heuristic that CRITERIA are required to make DECISIONS !

Full Analytical Criteria Prioritization Matrix

(1) Compare the criteria in EACH **row** with the criteria in EACH of the **columns** (i.e., a 'pairwise' comparison)

(2) Enter the appropriate **word** (e.g., **=Same**) for the comparison in the appropriate ROW and COLUMN.

For example, if Grades (**Row 1**) are Less Important than Learning (**Column 2**), then enter **=Less** in **R1/C2**.

(3) The HIGHER or LARGER the %, the MORE IMPORTANT the criteria.

=Much More Important	***=More*** Important	The ***=Same***	***=Less*** Important	***=MuchLess*** Important
9	3	1	0.333	0.111

Criteria		Grades	Learning	Mental	Physical	Relationship		
	X	**1**	**2**	**3**	**4**	**5**	Total	%
Grades	**1**	X	0.33	1.00	1.00	1.00	3.33	16
Learning	**2**	3.00	X	1.00	1.00	1.00	6.00	28
Mental	**3**	1.00	1.00	X	1.00	1.00	4.00	19
Physical	**4**	1.00	1.00	1.00	X	1.00	4.00	19
Relationship	**5**	1.00	1.00	1.00	1.00	X	4.00	19
							21.33	100

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Task Prioritization Matrix

Purpose

To improve any decision making process by rationally prioritizing, or ranking, tasks, issues, alternatives, etc. using weighted criteria.

Steps

1. Generate a set of criteria to be used in making a quality decision. Determine the weight for each criterion using the Full Consensus Criteria Matrix process.
2. Construct an L matrix with tasks, etc. down the left side and the selection criteria across the top.
3. Enter the 'full analytical criteria' weights in the L matrix in the row below the criteria.
5. For EACH criteria (or column), rank order all the tasks, etc. with respect to that criteria (e.g., using the modified nominal group technique). Enter the rank, or vote totals, for each task, etc. into the L matrix in the appropriate column and row.
   N.B. The higher the rank, or the larger the number, the more important the task.
6. Find the product of the individual rank, or vote totals, and criterion weight for each task (or row), etc. and sum these products for each row.
7. The rows with the highest sums are the issues of highest priority. Be sure to discuss any row which has a low total but seems like it should be retained. Always review the numerical values to determine if they 'make sense' to the team!

Note at the bottom of p. 48 and again at the top of p. 67,
the heuristic that CRITERIA are required to make DECISIONS !

Task Prioritization Matrix

(1) Enter the criteria and the numerical weights for each criteria in the appropriate rows below.

(N.B. This example uses Full Consensus Criteria from the matrix above.)

(2) Rank the **tasks** in EACH **row** using the criteria in EACH of the **columns**.

(N.B. The HIGHER the rank, or the LARGER the number, the MORE IMPORTANT the task.)
(For example, in the matrix below a rank of 5.0, or the highest value, is assigned to STUDY.)

(3) The HIGHER or LARGER the **%** , the MORE IMPORTANT the **task.**

	Criteria	Grades	Learning	Mental	Physical	Relationship		
	Weights	0.156	0.281	0.188	0.188	0.188		
Tasks	▨	**1**	**2**	**3**	**4**	**5**	Total	%
Attend Class	**1**	3.0	1.0	1.0	1.0	1.0	1.31	20
Homework	**2**	4.0	1.0	1.0	1.0	1.0	1.47	22
Recreation	**3**	1.0	1.0	1.0	1.0	1.0	1.00	15
Sleep	**4**	2.0	1.0	1.0	1.0	1.0	1.16	18
Study	**5**	5.0	1.0	1.0	1.0	1.0	1.63	25
							6.56	100

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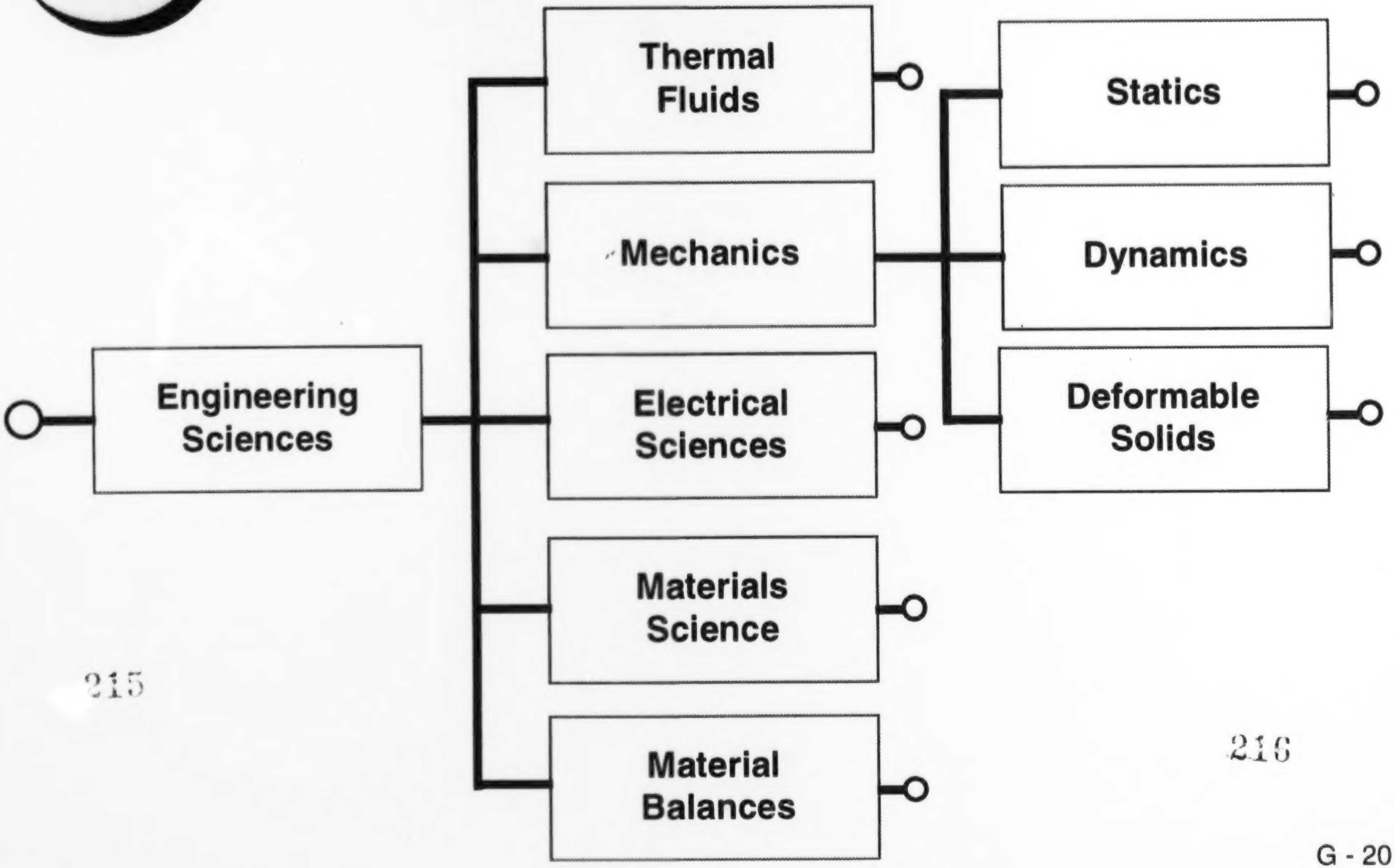
Process Check

- Monitoring of processes, especially processes which you own or are a part of, is necessary if improvement is desired
- A process check is a formalized way to do this monitoring and should be used at the end of all process related activities
- There are many different ways to conduct a process check
- A process check must focus on the process
- Failure of a process does not infer any judgment about the quality of the team members

Tree Diagrams, Conventions

- Each item placed on the tree has, for example, a direct cause-and-effect relationship with the item to the left of it, i.e., the second level of detail directly causes the first level of detail to happen.
- Each level of detail, for example, answers the question, ‘How will this be accomplished’?
- As you go from left to right, the level of detail gets finer.
- If the items at the lowest level of detail are ‘recognizable’ modules that can be implemented (e.g., can be assigned to someone else to accomplish), the tree is complete.
- Ask the following questions for example:
  - Going from right to left: ‘Will these actions really accomplish the next higher level of the task?’
  - Going from left to right: ‘If I want to accomplish this, do I really need to do all of these lower levels of detail?’

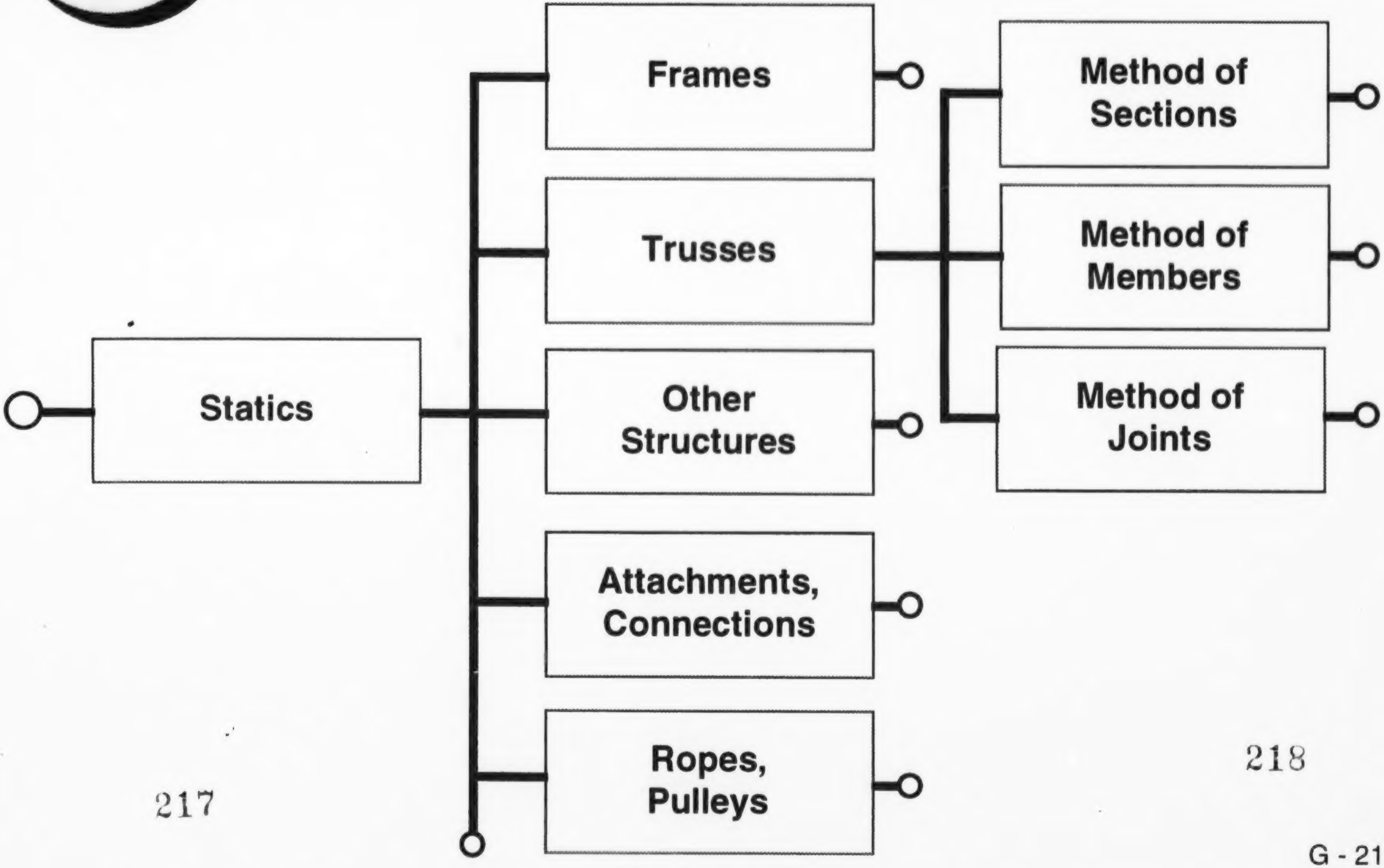
Tree Diagrams, An Example



Engineering Sciences

- Thermal Fluids
- Mechanics
  - Statics
  - Dynamics
  - Deformable Solids
- Electrical Sciences
- Materials Science
- Material Balances

Tree Diagrams, An Example (cont.)



Statics

- Frames
- Trusses
  - Method of Sections
  - Method of Members
  - Method of Joints
- Other Structures
- Attachments, Connections
- Ropes, Pulleys

SECTION H
Competency Matrix for Workbook

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Engineering Core Active Learning, Assessment & Team Training

Name: **Smith, Oveyon Guamon**

Last Update 12/29/94 7:54 PM

Before Class	●
After Class	☐

Learning Outcome	Competency Category	Competencies	Number	*Affective Objectives*			*Cognitive Objectives*					
			112	Receiving	Responding	Valuing	Knowledge	Understanding / Comprehension	Application	Analysis	Synthesis	Evaluation / Appreciation
1 Learning Culture	1 Introduction	A New Learning Culture	1.1 - 1	1			1					
		Also Self Evident Truths	1.1 - 2	1			1					
		ASU ... The Student is ...	1.1 - 3	1			1					
		Cone of Learning / Another View	1.1 - 4	1			1					
		Cooperative Learning Bromides	1.1 - 5	1			1					
		Definition	1.1 - 6	1			1					
		Harvard Assessment Seminars	1.1 - 7	1			1					
		Learning Pyramid	1.1 - 8	1			1					
		Learning Style / Consequences	1.1 - 9	1			1					
		Quality Principles	1.1-10	1			1					
	2 Active Learning Essential Elements	Face to Face Communication	1.2 - 1	1	1		1	1				
		Group (Team) Processing	1.2 - 2	1	1		1	1				
		Individual Accountability	1.2 - 3	1	1		1	1				
		Positive Interdependence	1.2 - 4	1	1		1	1				
		Social Skills Development	1.2 - 5	1	1		1	1				
	3 Active Learning Techniques	Think-Pair Share	1.3 - 1	1								
		Formulate-Share-Listen-Create	1.3 - 2	1								
		Numbered Heads Together	1.3 - 3	1								
		Jigsaw	1.3 - 4	1			1	1				
		Group Discussion with Talking Chips	1.3 - 5	1								
		Three Minute Essay	1.3 - 6	1								
		One Minute Paper	1.3 - 7	1								
		Structured Controversy	1.3 - 8	1								

Engineering Core Active Learning, Assessment & Team Training

Name: **Smith, Oveyon Guamon**

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Before Class ●

After Class ☐

			Number	Affective Objectives			Cognitive Objectives					
Learning Outcome	*Competency Category*	*Competencies*	112	**Receiving**	**Responding**	**Valuing**	**Knowledge**	**Understanding / Comprehension**	**Application**	**Analysis**	**Synthesis**	**Evaluation / Appreciation**
2 Assessment	1 General	Academic Journal	**2.1 - 1**	4	5		4	5				
		Competency Matrix	**2.1 - 2**	2	2		3	2				
		Portfolio	**2.1 - 3**	2								
		Reflection Log	**2.1 - 4**									
		Work Log	**2.1 - 5**									
	2 Cognitive Domain	Application	**2.2 - 1**	2	2		2	2				
		Analysis	**2.2 - 2**	2	2		2	2				
		Comprehension / Understanding	**2.2 - 3**	2	2		2	2				
		Evaluation	**2.2 - 4**	2								
		Knowledge	**2.2 - 5**	2	2		2	2				
		Synthesis	**2.2 - 6**	2								
	3 Affective Domain	Receiving	**2.3 - 1**	2	2		2	2				
		Responding	**2.3 - 2**	2	2		2	2				
		Valuing	**2.3 - 3**	2	2		2	2				

Engineering Core Active Learning, Assessment & Team Training

Name: Smith, Oveyon Guamon

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Before Class ●

After Class ☐

			Number	Affective Objectives			Cognitive Objectives					
Learning Outcome	*Competency Category*	*Competencies*	112	Receiving	Responding	Valuing	Knowledge	Understanding / Comprehension	Application	Analysis	Synthesis	Evaluation / Appreciation
3 Teams	1 Effective Meetings	Agenda	1.1 - 1	3	4		3	4				
		Evaluation	3.1 - 2	3	4		3	4				
		Facilitator	3.1 - 3	3	4		3	4				
		McNeill's Agenda Planner	3.1 - 4	3	4		3	4				
		One Hundred Mile Rule	3.1 - 5	3	4		3	4				
		Planning	3.1 - 6	3	4		3	4				
		Preparation	3.1 - 7	3	4		3	4				
		Records	3.1 - 8	3	4		3	4				
	2 Recurring Phases	Maintenance	3.2 - 1	3	4		3	4	5			
		Task	3.2 - 2	3	4		3	4				
	3 Roles, Responsibilities & Characteristics	Composition / Organization	3.3 - 1	3	4		3	4	5			
		Devil's Advocate	3.3 - 2	3	4		3	4	5			
		Encourager	3.3 - 3	3	4		3	4				
		Facilitator	3.3 - 4	3	4		3	4	5			
		Gate keeper	3.3 - 5	3	4		3	4				
		Leader	3.3 - 6	3	4		3	4	5			
		Member	3.3 - 7	3	4		3	4	5			
		Recorder	3.3 - 8	3	4		3	4	5			
		Sponsor	3.3 - 9	3	4		3	4				
		Time keeper	3.3-10	3	4		3	4	5			
	4 Stages of Team Development	Adjourning	3.4 - 1	3	4		3	4	5			
		Forming	3.4 - 2	3	4		3	4	5			
		Norming	3.4 - 3	3	4		3	4				
		Performing	3.4 - 4	3	4		3	4				
		Storming	3.4 - 5	3	4		3	4				

Engineering Core Active Learning, Assessment & Team Training

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Before Class ●

After Class ☐

			Number	Affective Objectives			Cognitive Objectives					
Learning Outcome	*Competency Category*	*Competencies*	112	Receiving	Responding	Valuing	Knowledge	Understanding / Comprehension	Application	Analysis	Synthesis	Evaluation / Appreciation
3 Teams	5 Decision Types	Consensus	**3.5 - 1**	3	4		3	4				
		Handclasp	**3.5 - 2**	3	4		3	4				
		Majority	**3.5 - 3**	3	4		3	4				
		Minority	**3.5 - 4**	3	4		3	4				
		Unanimity	**3.5 - 5**	3	4		3	4				
		Unilateral / Authoritarian	**3.5 - 6**	3	4		3	4				
	6 Sources of Power	Coercive	**3.6 - 1**	3	4		3	4				
		Expert	**3.6 - 2**	3	4		3	4				
		Legitimate	**3.6 - 3**	3	4		3	4				
		Reward	**3.6 - 4**	3	4		3	4				
		Unilateral / Authoritarian	**3.6 - 5**	3	4		3	4				
	7 Team Building Issues	Cohesiveness	**3.7 - 1**	3	4		3	4				
		Communication	**3.7 - 2**	3	4		3	4				
		Goal Specification	**3.7 - 3**	3	4		3	4				
		Interdependence	**3.7 - 4**	3	4		3	4				
		Roles and Norms	**3.7 - 5**	3	4		3	4	5			
	8 Task Classification	Additive	**3.8 - 1**	3	4		3	4				
		Compensatory	**3.8 - 2**	3	4		3	4				
		Conjunctive	**3.8 - 3**	3	4		3	4				
		Disjunctive	**3.8 - 4**	3	4		3	4				
		Optimize Quality	**3.8 - 5**	3	4		3	4				
		Optimize Quantity	**3.8 - 6**	3	4		3	4				
	9 Other	Definition	**3.9 - 1**	3	4		3	4				
		Use and Types of Teams	**3.9 - 2**	3	4		3	4	5			
		10 Common Team Problems	**3.9 - 3**	3	4		3	4				

Engineering Core Active Learning, Assessment & Team Training

Name: **Smith, Oveyon Guamon**

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Before Class ●

After Class ☐

			Number	Affective Objectives			Cognitive Objectives					
Learning Outcome	*Competency Category*	*Competencies*	112	Receiving	Responding	Valuing	Knowledge	Understanding / Comprehension	Application	Analysis	Synthesis	Evaluation / Appreciation
3 Teams	10 Social Norms	Code of Cooperation	**3.10 - 1**	3	5		3	5				
		Constructive Feedback	**3.10 - 2**	4	5		4	5				
		Definition	**3.10 - 3**	4			4					
		Enforcing Norms	**3.10 - 4**									
		Establishing Norms	**3.10 - 5**	5	5		5	5				
		Face to Face	**3.10 - 6**	4			4					
		First Seek the Intersection	**3.10 - 7**	4			4					
		Intervention Techniques	**3.10 - 8**									
		Listening Skills	**3.10 - 9**	4			4					
		Listening Techniques	**3.10 -10**	4			4					
		Overcoming Group NOthink	**3.10 -11**	4			4					
		Paraphrase for Understanding	**3.10 -12**	4			4					
		Person to Person	**3.10 -13**	5	5		5	5				
		Person to Team	**3.10 -14**	5	5		5	5				
		Personal Styles	**3.10 -15**	5	5		5	5				
		Roadblocks	**3.10 -16**	4	5		4	5				
		Talking Chips	**3.10 -17**	4	5		4	5				
		Team to Person	**3.10 -18**	5	5		5	5				
		Team to Team	**3.10 -19**	5	5		5	5				
	11 Total Quality Mgmt. Discussion Tools	Brainstorming Process	**3.11 - 1**	5	5		5	5				
		Affinity Process / Diagram	**3.11 - 2**	5	5		5	5				
		Force Field Analysis	**3.11 - 3**	5	5		5	5				
		Modified Nominal Group Technique	**3.11 - 4**	5	5		5	5				
		Process Checks (+/delta)	**3.11 - 5**	3	3, 4, 5		3	3, 4, 5				
		Process Checks (Likert)	**3.11 - 6**	4	4		4	4				

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TEAM SCHEDULE

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
7:00							
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